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# THE STRAWBERRY AND ITS CULTIVATION IN CANADA

BY

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WITH CONTRIBUTED CHAPTERS ON  
INSECTS AFFECTING THE STRAWBERRY

AND

STRAWBERRY DISEASES

DIVISION OF HORTICULTURE  
DOMINION EXPERIMENTAL FARMS

DOMINION OF CANADA  
DEPARTMENT OF AGRICULTURE

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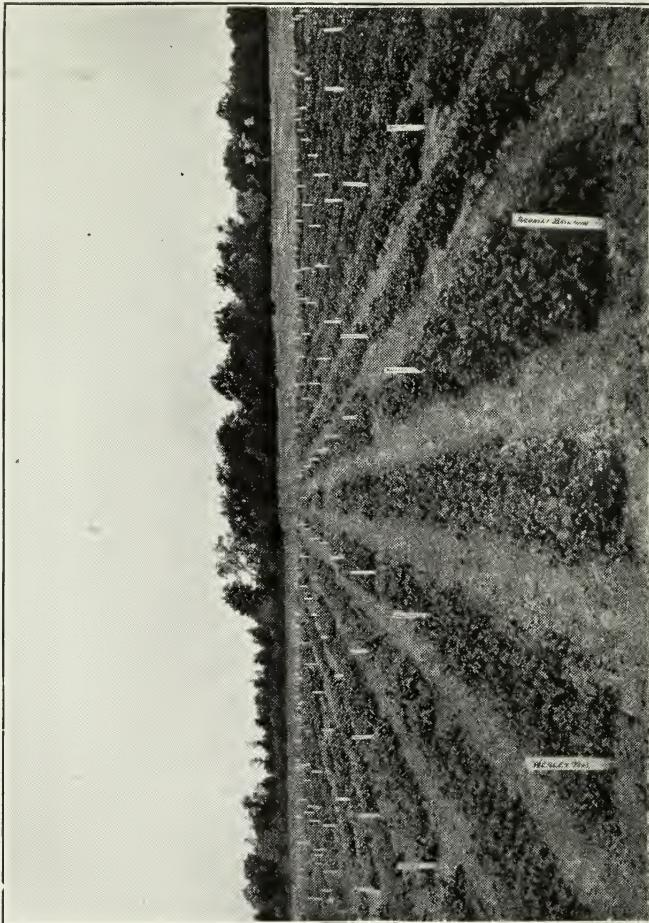
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**DOMINION OF CANADA  
DEPARTMENT OF AGRICULTURE**  
BULLETIN No. 80—NEW SERIES



Strawberry plantation, Central Experimental Farm, Ottawa. Blooming season.

# THE STRAWBERRY AND ITS CULTIVATION IN CANADA

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The strawberry is the most important of the small fruits of Canada and the United States. The latest census returns show production and value by provinces which indicate the widespread distribution of this cultivated fruit from coast to coast. This wide range of adaptability not only makes the strawberry popular from a commercial standpoint but also renders it especially desirable for the home garden in those parts of Canada where it is difficult to grow many edible fruits.

The strawberry is found wild in Canada from the Atlantic to the Pacific ocean, and from the southern boundary as far north as the 64th parallel. Large quantities of the wild fruits are gathered. The cultivated varieties are grown successfully almost everywhere where the wild ones are found, but in some districts they require protection or irrigation. The season for ripe fruit begins early in June in southern Ontario and in parts of British Columbia. At Ottawa the first ripe fruit has been obtained on June 17, and the last picking of the latest variety has been on July 19 for the varieties which usually bear only one crop in the season, but fruit is obtained from the everbearing sorts until late in October, unless frosts are severe. The season in the more southern parts of the province of Quebec is somewhat similar to that at Ottawa, except along the lower St. Lawrence, where it is much later, the fruit not being ripe until about the first week of July, and the season continuing until the second week of August. The season in Nova Scotia and Prince Edward Island extends into August also. In some parts of the Prairie Provinces, also, the season is not over until August. The later the spring and the cooler the summer, the later the strawberry ripens, as a rule.

With improved transportation methods the distance of shipping this fruit has greatly increased, until to-day it is not uncommon for carloads to be marketed several thousands of miles from their source of production. This places fresh strawberries on our markets over a very much longer period than would otherwise be the case and no doubt has much to do with keeping down the price during the early part of the local season. Nevertheless the local product always brings at the outset a somewhat higher price than the tail-end of the foreign product, principally because it reaches the consumer in better condition.

The following table shows the opening and closing dates of the strawberry season for 1924 at several of the Dominion Experimental Farms. Of course, there is a certain amount of seasonal variation in these dates, but the relative position remains about the same from year to year.

DURATION OF STRAWBERRY SEASON AT VARIOUS EXPERIMENTAL FARMS  
IN CANADA

Kentville, N.S. ....	June 30 to July 21
Fredericton, N.B. ....	July 2 to July 23
Ottawa, Ont. ....	June 25 to July 21
Morden, Man. ....	June 20 to July 24
Lethbridge, Alta. ....	June 16 to July 11
Summerland, B.C. ....	June 5 to July 8
Sidney, B.C. ....	June 4 to June 23

TOTAL COMMERCIAL PRODUCTION OF STRAWBERRIES AND VALUE BY  
PROVINCE FOR 1924

—	Quantity	Average price per qt.	Value	Estimated acreage*
	qts.	cts.	\$	
Nova Scotia.....	200,000	15	30,000	60
New Brunswick.....	600,000	17	102,000	180
Quebec.....	600,000	16	96,000	180
Ontario.....	3,607,000	13	468,910	720
British Columbia.....	2,925,000	24	702,000	600
	<b>5,932,000</b>		<b>1,398,910</b>	<b>1,740</b>

\*This is estimated on the basis of a conservative production per acre.

The largest proportion of the Canadian production is consumed in Canada. It is impossible to obtain figures showing Canada's export in strawberries, but judging from the export of "all small fruits" they would not exceed in value \$125,000.

In addition to the consumption of the home-grown product, Canada imports from the United States, about three million pounds of strawberries annually. The majority come in during the months of May and June, although there are some imported every month in the year, as will be seen from the following table:

MONTHLY IMPORTS OF STRAWBERRIES ENTERED FOR CONSUMPTION IN  
CANADA, AND EXPORTS OF "BERRIES FRESH OF ALL KINDS," BY  
COUNTRIES, FROM JANUARY TO NOVEMBER, 1925

*Imports Entered for Consumption*

Item	Month	United States	
		Lb.	Value
Strawberries.....	January.....	9,423	\$ 3,999
	February.....	18,062	5,124
	March.....	38,130	14,173
	April.....	188,908	67,454
	May.....	1,407,654	253,786
	June.....	1,476,921	260,749
	July.....	68,058	14,081
	August.....	937	386
	September.....	386	112
	October.....	369	95
	November.....	629	111
	Totals.....	<b>3,209,477</b>	<b>620,070</b>

*Exports*

Item	Month	United States	Alaska	New- foundland
		\$	\$	\$
Berries, fresh, of all kinds.....	January.....	9,842		
	February.....	4,334		
	March.....			
	April.....			
	May.....			
	June.....	16,176		
	July.....	91,276	21	58
	August.....	111,106	40	
	September.....	162,545		
	October.....	79,511		
	November.....	10,116		
	Totals.....	<b>484,906</b>	<b>61</b>	<b>616</b>

## LOCATION AND SOILS

The prospective strawberry grower if he has not already located, should bear in mind a few important details which may have a considerable bearing on the success of his undertaking. Proximity to a market or some good shipping-point is a very important factor. Very frequently growers located near a really good market net greater returns per acre than those who though located in far better fruit areas are either further from their market or are catering to a market too well supplied with this fruit. There are still excellent opportunities for the establishment of strawberry plantations close to some of our larger cities and towns which are at present largely dependent for their fruit supply upon distant sources. This closeness to an excellent market goes a long way towards making up for other deficiencies such as possible winter injury, lower yields due to weather conditions, etc.

The possibility of being able to obtain pickers is another important factor which will have an influence on the area to be planted. With the advent of motor transportation this is easier of solution than formerly, for it is now possible to gather up the pickers from a nearby city or town and in a few minutes transport them to the fields where they may remain for the day to be returned in the evening by motor truck.

The actual location of the plantation, however, depends upon factors governing the economical production of the crop. Among the most important of these is to select a situation where good drainage is obtainable. It is not sufficient that underdrainage be present, good surface drainage is absolutely necessary for assured success. The strawberry will not stand being covered with water in early spring or during the late winter. Unless there is sufficient slope to the land this is difficult to overcome in some years, when the ground is frozen for a time after the early spring melting of snow, thus rendering the underdrains of little use for a short period.

Low-lying pockets are also to be avoided especially in districts where late spring frosts are liable. A gentle hillside or slope permits of better air drainage and often eliminates this trouble entirely.

### SOILS

The strawberry will thrive on a great variety of soils, from a very light sand to a heavy clay, but when it is possible to make a selection, a moderately light friable soil is much to be preferred. From the standpoint of the physical texture a light sand is satisfactory, but being generally deficient in humus and plant food it is not as valuable as a heavier sandy loam or a very light clay loam.

As it is important to get the young runner-plants rooted as early as possible, a soil which does not pack or bake is much more suited to strawberries than a stiffer but possibly naturally richer, soil. If a stiff clay is used, constant cultivation and care during the first year is very important.

**Soil Moisture.**—There is considerable variation in locations with reference to their moisture content during a dry season. This is frequently dependent upon the depth of the soil and also upon its physical texture. This is an important consideration where dry spells are frequent during the strawberry-picking season. At the Central Experimental Farm, the soil is a very light sandy loam and, while rather exacting in its fertilizer requirements, has a desirable physical texture rendering it easily worked. On account of its great depth this soil is very retentive of moisture and, although often dry on the top inch, shows plenty of moisture below. The fact that the top inch dries out quickly and forms a natural dust mulch is probably largely accountable for the slow evaporation of moisture from the lower depths. A heavier textured but richer soil would probably not be as retentive of moisture.

CULTIVATED LAND.—Land which has been in sod for some years should be avoided until a few hoed crops have been grown on it. Such land is liable to be heavily infested with white grub, which causes material damage to a newly set plantation. This pest is not so prevalent on land which has been cultivated for a few years.

### **PREPARATION OF THE SOIL**

As stated in the previous paragraph land under cultivation is preferred for a new strawberry plantation. Another exceedingly important factor is control of weeds, especially if the plantation is to be kept for more than one year's fruitings. It is advisable to avoid, therefore, land which is infested with couch grass, or other persistent weeds difficult of control.

A thorough ploughing, disking, harrowing and rolling is necessary before planting. Fall ploughing on certain soils is to be preferred, followed with a thorough pulverization and a levelling and smoothing by a spring-tooth harrow. For ease in planting, rolling is generally recommended previous to the field being marked out.

### **FERTILIZERS**

The fertilization of the land for a successful strawberry crop is dependent upon a number of factors. As the crop occupies the land for at least two seasons, it is rather exacting in humus, which is quite essential for the proper retention of moisture and the liberation of plant-food. As humus can only be supplied by green manure crops or by manure, the quantity to be supplied before the plantation is set out will depend upon the nature of the soil and the length of time the plantation is to be fruited.

On very light sands large quantities of humus will need to be supplied; on loamier soils humus is not such a vital consideration. If only one crop is to be taken from the plantation a smaller amount of humus will be required than where two or more crops are to be removed.

As manure, in addition to its humus content, contains large quantities of nitrogen, phosphoric acid, and potash, it makes probably the best fertilizer that can be supplied, although it may be necessary to supplement it with some form of commercial fertilizer. Failing an abundant supply of manure, a rotation which will permit of the ploughing under of a crop of green manure, such as one of the clovers or some other good legume, will supply not only humus but also a quantity of nitrogen.

It is thus quite possible by the use of green manure crops and fertilizers to maintain both the humus content and the plant-food of the soil. This is of particular advantage to growers of small fruit who are finding it increasingly difficult to procure manure. The method entails the idleness of the land for one full season, which adds to the cost of seed and planting the interest on the land value for one idle season. The cheaper the land employed, the more economical this method becomes.

Any additional nitrogen required may be applied as nitrate of soda, or ammonium sulphate; phosphoric acid as acid phosphate or as bone meal; and potash as muriate of potash.

### **ROLE OF NITROGEN IN STRAWBERRY CULTURE**

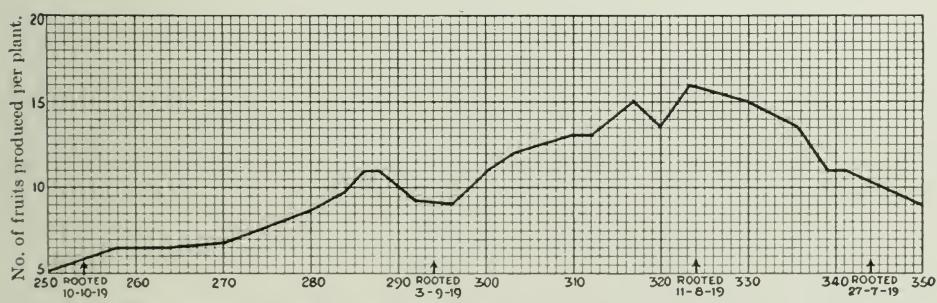
Nitrogen is the most unstable of our plant-foods and is more often deficient in the soil than other elements; consequently beneficial results are very frequently observed from nitrogen applications. In order to determine the effect of nitrogen at different seasons of the year a series of experiments was inaugurated at the Central Experimental Farm, the results of which are given below.

There are at least three ways in which applications of a nitrogenous fertilizer may affect the yield of strawberries, viz. (1) by causing an actual increase in the number of flowers or fruit-buds formed; (2) by causing an increase in the size of the individual fruits; and (3) by increasing the set of the bloom.

(1) This is probably the most important. In the annual report of the Horticultural Division for the year 1921, evidence was presented to show the value of early-formed runners in the plantation. The following table taken from that report shows clearly the comparative value of early- and late-formed stolons or runners as fruit-producers. The early formation of runners is dependent upon an available supply of plant-food, including nitrogen, in the early part of the planting year. The presence of nitrogen therefore affects the number of fruits formed by encouraging the early formation of runner-plants during the first year of the plantation.

TABLE SHOWING THE PERCENTAGE OF STOLONS FORMED ON DIFFERENT DATES

Date	Percentage
July 7	0.37
" 14	1.11
" 16	0.61
" 18	0.74
" 21	0.25
" 23	1.23
" 25	0.61
" 26	0.12
" 28	1.11
" 30	0.61
 6.76% formed during month of July produced 6.5% of the fruit.	
Aug. 22	0.98
" 6	1.11
" 8	0.25
" 11	2.21
" 14	1.11
" 18	3.08
" 22	16.36
25.10% formed during month of August produced 34% of the fruit.	
Sept. 3	7.13
" 8	0.49
" 18	16.61
" 19	0.12
" 20	0.71
31.36% formed during month of September produced 39% of the fruit.	
Oct. 10	27.43
After Oct. 10	11.79
39.22% formed during the month of October produced 19.6% of the fruit.	



Age of the plants in days, dating from time of formation to July 1, 1920. Figure No. 1, showing relation between yield and age of the stolon.

Dealing first with that part of the experiment where stolons were permitted to remain in their original position, it was found that there was decided correlation between the date the stolon rooted and the ultimate number of fruits it produced. Stolons formed as late as October 20 produced, on the

average, only five fruits, whereas stolons formed about the middle of August produced an average of sixteen fruits. This is portrayed graphically in the figure 1. Runners formed much earlier than this produced about nine to ten fruits. Apparently the reason for the falling off of these extremely early-formed stolons is due to the fact that these are the parents of large numbers of stolons and, like the original parents, become depleted of energy. The number of these early, poor yielders is comparatively small, as will be seen by examining the preceding table which shows the percentage of stolons formed on the different dates. From an examination of this table and the figure, it is evident that the most profitable period of stolon formation lies between the latter part of July and the last of September. Although over one-third of the stolons were formed in October they produced only 19·6 per cent of the crop, which, when compared with 34 per cent of the crop produced by 25 per cent of the stolons which were formed in August, demonstrates the great value of early planting and good care in the early part of the season.

Further work with nitrogen applications has shown that when a heavy application of manure is applied the year previous to planting and the land used for a hoed crop, there is on an averagely good soil a sufficient supply of nitrogen and other plant-food to encourage maximum runner formation in the early part of the season. This same series of experiments demonstrated, however, that even though there appeared to be a sufficient supply of nitrogen to promote maximum vegetative extension or runner formation, an application of nitrogen made in September of the planting year caused a very appreciable increase in yield. The exact yields of the plots treated at various times were as follows:—

	Yield per plot Lb.
Nitrated 1 month after planting.....	22·30
"    August 15.....	23·00
"    September 15.....	23·30
"    September 15 and again in spring.....	24·20
Not nitrated at all.....	19·10

The table shows a gain of over 4 pounds per plot derived from the application of nitrogen by making the application of nitrogen at a period when there were a large number of plants forming their fruit-buds for next year's crop.

(2) The size of the individual berry or fruit, may further affect the total yield. This may be influenced by spring applications of nitrogen, especially in soils where nitrogen is inclined to be deficient.

(3) Spring applications of nitrogen may also increase the ultimate yield by improving the set. As in size, this would be more evident in soils low in nitrogen than where the supply of nitrogen is abundant. Results from our experiments indicate that the total set of all bloom was increased by about 5 per cent by a spring application of nitrogenous fertilizer before bloom. A closer analysis showed that the increase on the later blooms such as the quartenary or last formed blossoms ran as high as 26 per cent.

#### HOW TO APPLY FERTILIZERS

AMOUNTS.—The amount of fertilizer to apply per acre depends, of course, upon the soil in question and any recommendations given here can only be very general in their application.

An application of from 20 to 30 tons per acre of manure is generally considered a fair application. In addition to this an application of nitrate of soda in September at the rate of 200 to 300 pounds per acre is generally attended with good results. If used in the spring of the fruiting year a further application of 150 pounds per acre should prove sufficient. While the most of the experimental work conducted so far has demonstrated that the average soil is

not as deficient in phosphorus and potash as in nitrogen, it appears advisable to use these elements where manure is not available. Muriate of potash, 200 to 300 pounds and 200 to 300 pounds of bone meal or acid phosphate broadcast before planting may be used to take the place of the manure or to supplement light applications of it.

**How to APPLY**—In using commercial fertilizers they may be broadcast on the soil previous to planting, and cultivated in or applied between the rows shortly after planting and worked in with regular cultivators.

A word of caution is pertinent at this point. We have observed that applications of nitrogenous fertilizers made at planting or very shortly after, often give injurious results, the young plants not being able to utilize much fertilizer at that time. It is recommended, therefore, that fertilizers such as nitrate of soda or sulphate of ammonia be not applied until at least one month after the plants are set.

Where nitrogenous fertilizers have been used after the plants are forming runners, we have had good results from broadcasting nitrate of soda right on the plants during a dry day. On such a day very little adheres to the foliage, and if a piece of bagging or brush is dragged over the plantation any nitrate that does adhere is quickly dislodged. With sulphate of ammonia, we have not been so successful, getting a considerable amount of foliage injury when used in this way. Apparently between the rows is the only method of application for this fertilizer.

#### PLANTS AND THEIR TREATMENT

If the plants are obtained from a distance it is desirable to order more than are actually required, as there is usually considerable loss. By heeling in the extra plants they can be used to fill vacancies as soon as it is known which plants are not going to grow. If, however, plants of the desired varieties can be obtained



No. 1—Over-developed crown, and too small a root.

No. 2—Crown and root too small.

No. 3—A very young and unsuitable plant.

No. 4—A properly developed plant for transplanting.

near home, they will, as a rule, be found much more satisfactory because most of them are likely to grow. Plants should be ordered to arrive as early in the spring as possible after the soil can be worked, and planted soon after their arrival. It is often, however, not convenient to plant at once; but in any case, the parcel

containing the plants should be opened up when it arrives, otherwise they are liable to heat or dry out, and either condition should be avoided if possible. Roots which are in good condition are of a light or yellowish colour, while those which have heated are dark and it is a waste of time setting out plants with such roots. The plants when not planted at once should be heeled in where water will not lie. A trench is opened sufficiently deep to cover the roots of the plants in the first trench. The soil should be firmly tramped or packed against the roots.



A first-class plant, trimmed for planting; plenty of young white roots.

so that the soil will not dry out. If loosely heeled in they are likely to dry out and the plants die. It will help to keep the plants alive if they are partially shaded and watered if the soil seems dry. By the time the soil is ready for planting these heeled-in plants may have made new roots and be in better condition for planting than if they had been set out at once. The number of plants required for an acre if set out 18 inches apart, in rows  $3\frac{1}{2}$  feet apart, is

about 8,300, and to provide for loss in shipment at least 8,500 should be ordered. If a free-plant-maker like Senator Dunlap is planted, the plants need not be less than 2 feet apart, and 6,500 plants should be sufficient to order.

The best plants for autumn planting are what are known as pot-plants. These are obtained by sinking 2½-inch pots to the rim in the ground several weeks before the plants are to be rooted. The pots are filled with rich friable soil and sunk from 6 to 8 inches from the original plant. As soon as the new runners reach the pots, they are placed over the soil and soon root and make good plants by late summer. The advantage they have over plants rooted in the ordinary way is that when they are transplanted they are taken from the pot and replanted with a ball of earth without disturbing the roots. Hence they are but little checked and will soon go on growing again, making strong plants which will bear more fruit than those rooted in the ordinary way.

Before planting it is a good plan to remove all the developed leaves of the plants except about two of the healthiest ones. This prevents too rapid transpiration of moisture before the plant becomes established, and may often save it when dry weather sets in immediately after planting. Long and straggling roots may also be cut off at this time, the removal of about one-third of the roots being a good practice.

**HOME-GROWN PLANTS.**—When possible, it is better for the grower to raise his own plants as they can be dug and used fresh. For this purpose it is more desirable to have a propagating area than to take from old beds which have fruited or from the outer edge of the newer rows which are going to fruit for the first time.

In raising plants for propagation, whether the general system is the hill plan or not, the propagating area is of course laid out for matted rows. A very good plan is to set the originals in rows with every other row 3 feet to 3½ feet apart and the rest 2 feet apart. In this way the two rows which are separated by only 2 feet can be allowed to mat together while the rows 3½ feet apart can be cultivated. Thus there will be a wide matted row of plants ready for digging the following season.

**SELECTING THE PLANTS.**—In selecting the plants for transplanting the whole propagating row should be dug and the best plants only selected. These are plants with a large root system and well developed crowns. The oldest plants with oversize crowns and smaller root systems should be avoided, likewise those with very little root and small crowns. Aside from this, our experience shows that it matters little whether the plant comes from close to the original parent or far from it. Only those plants with good white roots are used. The ones with dark or discoloured roots are probably too old or have been injured by winter, and are discarded.

#### **PLANTS FOR SHIPMENT**

In shipping strawberry plants great care is necessary in packing to avoid drying out and overheating. At the Horticultural Division, Central Experimental Farm, three sizes of packages are commonly used. One size is a small mail package, for from 1 dozen to 50 plants, the other is an ordinary 11-quart basket for 100 to 200, and the other is a regular slatted crate for large shipments.

(1) The small mail package is very popular for customers only wishing small lots and if care is taken in packing, is satisfactory for quite long distances. The plants are tied into a bundle with raffia and then wrapped around with sphagnum moss, which has been well soaked and squeezed free of surplus water. A piece of oiled paper is then securely wrapped around the package so that the

leaves are exposed (see illustration) and the whole then wrapped and tied in manila wrapping paper. If preferred, one may use a specially prepared paper which consists of two layers of paper stuck together by tar compound. This is both waterproof and airproof and prevents drying out (which is the object of the oiled paper) while the open end provides the necessary ventilation.



Eleven-quart basket package before wrapping.



Eleven-quart basket package ready for shipment.

(2) The basket package consists of an 11-quart basket without the handle, and is very useful where from 100 to 200 plants are to be shipped. The basket is simply lined with a piece of oiled paper or other prepared paper and then lined with moss, the plants being packed in upright with moss between every few layers. A piece of burlap over the whole makes it secure and permits of sufficient ventilation.

(3) For large shipments a regular strawberry-crate is an excellent package. It is desirable to line the crate with oiled paper and then with a thin layer of wet moss. The plants can then be packed in an upright manner with a little moss between each layer. After the first tier of plants is in, if it is necessary to put in a second, a slatted bottom may be inserted and cleats fastened to the sides, and the second tier packed as the first. After the crate is filled a slatted top without any further covering completes the package.



Mail-package ready for shipping.

### **PLANTING**

Strawberries may be planted either in spring or fall, but generally it is recommended that spring planting be adopted. Some people think that by planting in August they can obtain a sufficient stand of plants to obtain a crop the next year. Even when using pot-layered plants this is exceedingly difficult and little benefit is gained. There is, however, another aspect which may favour fall planting, but in this case it would be planting in the fall preceding an anticipated spring planting for the purpose of inducing earlier formed stolons or runner-plants. Plants set in late August or September in a favourable location generally come through the winter very satisfactorily, and will commence runner formation earlier than spring-set plants. By a reference to the paragraph on the value of these early formed runners it will readily be seen how fall planting might materially increase the crop. In this case it would be necessary to remove surplus runners in the early part of the second fall to prevent overcrowding. The greatest disadvantage in fall planting is the frequency of dry spells in the autumn which makes transplanting difficult and uncertain until too late in the season. Of course where irrigation is available this factor is eliminated.

When spring planting is practised it should be the object to plant as early as possible to get the benefit of the cool weather and moisture of that time of year.

Before commencing planting operations it is important that the soil be in first-class condition. Brief mention was made of this in an earlier paragraph but it will not be amiss to again draw attention to the matter. On light loamy soil, after the disk and levelling harrows have completed their work it will generally be sufficient to roll the land before marking, but if the soil is at all inclined to lumpiness, it is good practice to go over it with a planker previous to rolling.

As soon as the distances have been decided upon, the rows may be marked with a marker and then again cross-marked so that the plants may be set where the lines intersect. Long rows are desirable, as, with them, time will be saved in cultivation. Planting may be done with a spade or with a trowel or dibble, and some growers stake off rows one way from  $3\frac{1}{2}$  to 4 feet apart, and with a light plough make a shallow furrow and then set the plants about 18 inches apart along the sharp edge of the furrow, drawing the soil about the plant and firming



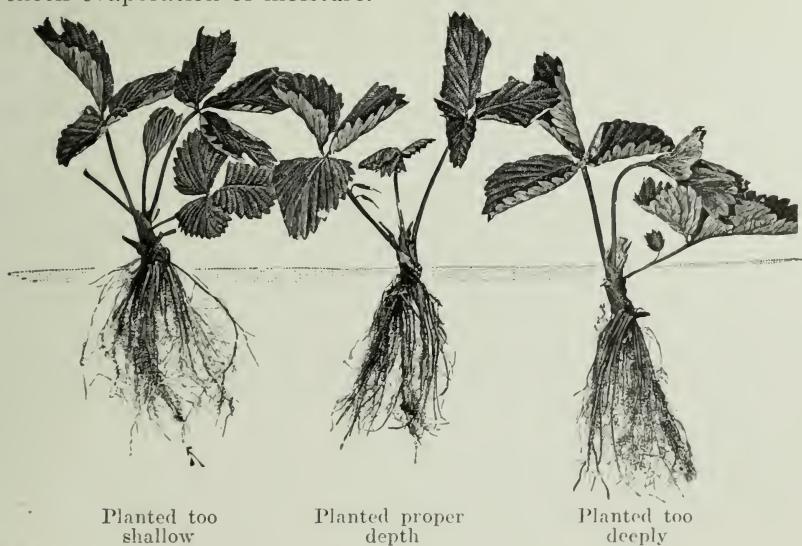
A quick method of marking out rows.

it well with the hand. When planted with a spade two persons are required to do the work, usually a man and a boy. The man takes the spade and opens the hole by forcing the spade into the ground, pressing it forward and backward. As soon as it is withdrawn, the boy places a plant in position and the man presses the soil firmly against it with his foot. This method is very rapid and if the soil is well pressed against the plant, is quite successful. A surer method of obtaining a stand is by using a trowel or dibble for opening the hole, whereby the plant is more likely to be set the proper depth, and more care usually exercised in spreading the roots and firming the soil about the plants. By this method the same person opens the hole and sets the plant. Great care should be taken to have the crown of the plant just at the surface of the ground after it has been pressed in when planted. If the plant is set too high the roots and crown will dry out, and if too low will be smothered. Care should be taken when planting to spread the roots against the side of the hole. Planting



Spade method of planting.

machines are used by some growers, and give good satisfaction when the work is well done, the soil in very good condition, and the season favourable. When the soil is not in good condition and not well levelled, the plants are sometimes set at different depths and the stand is not good. When planting, the plants should be carried in wet sacking or in a pail with water in it, as the roots must not be allowed to become dry. The surface soil should be left loose after planting to check evaporation of moisture.



Professor T. G. Bunting of Macdonald College has the following to say on the use of transplanting machines on large areas:

"A transplanting machine is indispensable on the larger acreages of strawberries. It greatly reduces the cost of planting, increases the speed and provides facilities for watering the plants as they are set in the rows if the soil is somewhat dry. It is operated by a man and team, with two boys, who, seated at the rear and at the sides place the plants in the trench made by the machine. The depth of this trench and the amount of water applied may easily be regulated. This machine, with experienced labour will set as many as 25,000 plants, three to four acres, per day at a cost of 40 to 50 cents per thousand. To this must be added some additional cost for the more careful preparation of the plants for machine planting as compared with hand-setting. The plants should be carefully prepared and be uniform in size, and have the roots well straightened out and all dead leaves and runners removed so that the operators may handle them as rapidly as the machine moves. In loose or light soil the machine may not pack the soil firmly enough about the roots, and the operators may miss an occasional plant especially at the ends of the rows. In this case it is well to have an additional man follow the machine to tramp the soil about the plants, straighten misplaced ones, and fill in any gaps that may occur. Careless planting may mean greatly decreased yields and low returns."



Planting-machine; showing box containing plants.  
(Courtesy Ont. Govt. Motion Picture Bureau)

#### THE MATTED-ROW SYSTEM

There are in general two systems of growing strawberry plants, the matted row, and the hill system.

In Eastern Canada most commercial growers use and prefer the matted row, whereas in British Columbia the hill system is in general use. The great objection to the hill system in the East is the liability to heave which causes considerable root and crown injury with consequent reduction of crop. After six years of repeated trials with the hill system at the Central Experimental Farm, Ottawa, in only one season did the acreage yields approach those obtained from the matted-row method.

In planting for the matted row the distance apart of the row and of the plants in the row is to some extent regulated by the varieties used. But taking into consideration the value of having as large a percentage as possible of



Planting-machine; showing operator ready to place plants.  
(Courtesy Ont. Govt. Motion Picture Bureau)



Full view of planting-machine.  
(Courtesy Ont. Govt. Motion Picture Bureau)

August-formed plants, comparatively narrow rows will give greater returns per acre than wider ones. When a large number of narrow rows are obtained it becomes possible to get a full stand of plants earlier in the season after which later formed runners may be removed by an edger or cutter. A distance of 3 to 3½ feet between the rows as planted is ample and the distance apart of the plants in the row may be regulated by the varieties used. Senator Dunlap, a very prolific plant-maker may be safely set at 24 inches while varieties like Parson, Glen Mary, and Portia are satisfactory at 18 inches.

While many who grow strawberries in the matted row do not take the trouble to place the runners as they form, but let them root without assistance, it pays to place them, as the sooner they take root the stronger the plants will be by autumn, and the more fruit will be produced next season. All that is necessary to do is to place the runners so that they will be as nearly as possible uniformly distributed in order to economize space, and to put a little soil over them to hold them in place but leaving the terminal buds bare. In the Prairie Provinces where winds prevent the prompt rooting of runners, it is important to hold them in place until they root with pieces of sod, stones, an inverted crotch, or by any other suitable method. To get the best results, runners should not be nearer than from 4 to 6 inches apart, preferably 6 inches, all others being destroyed; but in practice it is often difficult to accomplish this and to restrict them to this area, as some varieties make a great many runners. These are, however, the kinds which have the most need of thinning, as when the plants are very thick the fruit is too small. The width of the row formed by autumn will depend on the number of runners which are made, but if planted early and properly cared for, most varieties will make a row two feet or more wide. At this width there would be a path 18 inches wide left for the pickers between the rows. As some varieties would cover the whole space between the rows with runners in one season, it is necessary to remove those not wanted with the cultivator or hoe.

The so-called single-hedge and double-hedge-row systems are merely modifications of the matted row. The runners, instead of being allowed to form indiscriminately, are most of them removed and the rest placed where it is desired for them to grow. In the single-hedge-row system, two or four runners are left on, and these are placed in line with the row on each side of the parent plant.

When grown in this way the rows are 2½ to 3 feet apart and the original plants about 2 feet or more apart in the rows. When the row is formed the plants are 6 to 8 inches apart in a single row.

In the double-row system, six runners are left to each plant in the row and two on each side of the original row, all about equal distance apart. Trained in this way the original rows should be about 3 feet apart and the plants 2 feet or more in the row.

The twin-edge-row system provides for two rows 16 to 18 inches apart with the plants at first about 2 feet apart in the row, with a wider space of 2 feet for a path and for cultivation between each pair of rows. The hedge-row system requires considerably more labour than the matted row, but the returns will often well pay the grower for the extra amount of work. By this method the plants get more opportunity to develop strong crowns; better cultivation can be given, and more of the plant food in the soil will be available, resulting in larger and better fruit.

#### HILL SYSTEM

This system is the one largely used by British Columbia growers excepting those of the Okanagan and West Kootenay. In this system the plants are generally set about 3 feet by 18 inches. This permits of cultivation both ways during the first season. Where this method succeeds large berries may be grown. The blossoms are pinched off the first season as in the matted-row system and

all runners are removed as formed and before rooting. This will generally require about four or five cuttings, and may be done with a knife, a very sharp hoe or a pair of sheep-shears. By this method very strong crowns are developed; the plants having more room, become vigorous and as a result the fruit is large, and sometimes as good crops are obtained as from the matted row.

However, winter injury is much more likely to occur when plants are grown individually, and if plants grown in hills die from heaving or from some other form of winter-killing they leave large blanks, causing a great lessening of the crops. Unless kept well cultivated or well mulched in summer, plants suffer more in dry time in hills than in the matted row where the crowns are better protected by foliage. If the plants are kept well mulched, very fine fruit is produced when strawberries are grown in hills, which sometimes makes this method preferable when growing strawberries for home use. In the milder parts of British Columbia, especially where there is a dry summer without irrigation water available, the hill system is used, as the ground can be kept cultivated and moisture conserved.

The Dominion Experimental Station for Vancouver island, at Sidney, British Columbia, has published the following report on a trial of several systems of growing strawberries under their conditions.

#### SYSTEM OF PLANTING—VANCOUVER ISLAND

Method of growing	1924				1925			
	Yield crate berries	Yield jam berries	Total yield	Per- centage crate berries	Yield crate berries	Yield jam berries	Total yield	Per- centage crate berries
	lb. per acre	lb. per acre	lb. per acre		lb. per acre	lb. per acre	lb. per acre	
Hill.....	3,826	1,618	5,444	70·2	814	1,355	2,169	37·5
Hedge row.....	3,878	1,693	5,571	69·6	605	702	1,307	46·3
Half-matted row.....	3,391	1,751	5,142	65·9	1,549	1,113	2,662	58·2
Full-matted row.....	1,510	1,002	2,512	60·1	1,321	1,284	2,605	50·7

#### *Yield for two years*

Hill.....	4,640	2,973	7,613	60·9				
Hedge row.....	4,483	2,395	6,878	65·1				
Half-matted row.....	4,940	2,864	7,804	63·3				
Full-matted row.....	2,831	2,286	5,117	55·3				

It will be noted that in one year (1924) the hill system outyielded the full-matted row by over 115 per cent, and in 1925 the matted row outyielded the hill system by about 20 per cent, while the results for two years was decidedly in favour of the hill system.

During the first season frequent cultivation is essential to success. As soon as the plants are set out a cultivation with a spike-tooth cultivator should be given. This should be followed up at intervals of about two weeks or oftener, largely depending upon soil and weather conditions. Not only is this cultivation necessary for the elimination of weeds, but also for maintaining a friable condition of the soil necessary for the young rooting runners, and to provide air to the soil for the liberation of plant-food. On all except very light soils the early cultivations (after the first one) should be fairly deep, in order to loosen the soil and promote soil activities. For this purpose a scuffler will generally give better results than the spike-tooth. The strawberry, being a plant whose roots go almost straight down, can be cultivated at close quarters.

Hoeing will also be necessary to destroy weeds which cannot be got at by the cultivator. Some growers prefer a wheel hoe or hand cultivator for this

purpose, and generally two or three times during the first year is all that is necessary to go over the plantation with this implement. As the season advances and the runners commence to form, it will become necessary to narrow the cultivator in order not to disturb the newly rooted plants. After midsummer when light cultivation is sufficient, the spike-tooth cultivator is used. The placing of the runners can usually be done when hoeing through the plantation. On small plantations it is generally possible to pay more attention to this than on larger areas. It is a good plan when cultivating to start always from the same corner and in the same direction, as in this way one is not so liable to rip out plants which the cultivator has previously trailed into position.

### WINTER PROTECTION

After permanent frost has set in and the ground is quite solid, the plants should be covered with a light coat of clean straw, that which will not pack closely over the plants being best. Marsh hay is good and free from weed seeds. Green manure is sometimes used, but as it usually contains many weed seeds,



Strawberry plantation, Central Experimental Farm, Ottawa, Canada. Mulched for winter.

and sometimes may smother the plants, it is not recommended. This mulch will prevent the alternate thawing and freezing of the ground in the spring and protect the plants if there is not much snow in winter. It prevents heaving also which often causes much loss on heavy soils. A heavy mulch may cause heating in the spring before it is removed, and as a light mulch of 2 or 3 inches is sufficient, more should not be used. The amount required is from 3 to  $3\frac{1}{2}$  tons per acre.

It has occasionally been recommended to grow something between the rows of strawberries during the latter part of summer, which could be used to hold the snow in winter. This is not a desirable plan as, while growing, the crop exhausts the moisture from the soil at the expense of the strawberry plants. In

those parts of Canada where injury from spring frosts is frequent, it is desirable to hold plants back as long as possible. For this purpose, after the first heavy fall of snow, the snow is covered with straw or evergreen boughs, which are left on as long as possible in the spring. While plants will often come through the winter without protection, it is best not to take any risks. After the frosty



Mulching strawberries on the Prairies at the Experimental Station, Morden, Man.

weather of early spring is over and before the plants begin to grow, they should be uncovered and the straw put between the rows to keep the fruit clean. If the soil is one which bakes or dries out easily, it is a good plan to remove the mulch, cultivate the ground and put back the mulch between the rows when conditions will be better for conserving moisture. As soon as the fruit has been picked, the straw should be removed altogether, and the plantation ploughed up. If left for another season, it should be weeded and the surface soil loosened with the cultivator so that the new runners will have a chance to root.

#### RENEWING THE PLANTATION

The most satisfactory results are obtained when only one full crop is gathered from a plantation. If, for instance, plants are set this spring, the plantation should be ploughed up after the fruiting season of next year. There will thus be a new plantation made every year. By this system, much better fruit is obtained as the plants are not so thick in the row and the soil can be kept freer of weeds. Where the white grub is troublesome, it is important to renew the plantation every year, as this pest increases rapidly in old plantations and sometimes almost ruins the crop. It is quite possible to obtain two good crops or even more from a plantation by careful management, but the older the plantation the less the crop will be and the smaller the fruit as a rule. In the Maritime Provinces where the summer is relatively cool and moist, plantations are left longer than in the drier and warmer parts of Canada.

### RENOVATING AN OLD BED

If the land is free of weeds it is quite possible to obtain good results by keeping a plantation longer than the one year. This usually entails a certain amount of renovation at the end of the first fruiting season. The amount and system of renovating will largely depend upon the condition of the plantation. Our experience at the Central Farm has shown that where we manure the year previous to planting, and depend upon fertilizers for subsequent applications of plant-food, we are troubled very little with weeds. Under such conditions it is comparatively easy to renovate. The method is as follows: as soon as the picking is over, the straw is raked up and carried to one side of the plantation. After this, each row is ploughed or cut down to a width of about 18 inches. The plants thus ploughed up are then gathered up and destroyed, and the cultivator run through the rows. The few weeds growing among the remaining plants are pulled by hand. As soon as this cleaning up has taken place,



Renovating an old strawberry patch. The rows are just narrowed down by ploughing through the centre.

an application of nitrate of soda is made to the plantation at the rate of 200 pounds or more to the acre. Sulphate of ammonia would be satisfactory only that we have not been able to broadcast it over the plants without serious burning. If used it should only be put between the rows. Frequent cultivation throughout the balance of the year will usually result in the plantation going into winter quarters in very good condition.

When the old bed is grown up with grass and weeds, more drastic measures are necessary. In such instances, after the removal of the straw the whole plantation is mowed and the mowings burned as quickly as possible. After this the rows are narrowed down to about 1 foot in width and the ploughed-out plants raked up and destroyed. This leaves a narrow row of plants and weeds that can then be hoed to leave clumps of plants every 8 or 9 inches.



Renovating an old strawberry patch. After ploughing the rows, the land between the rows is hoed to turn up the old plants.



Renovating an old strawberry patch. After cultivating, hoe around the plants left with a three-cornered hoe, and weed.

In narrowing the rows it is always well to work from one side of the plantation so that the old row is split down the centre leaving the newer plants on the outer edge as the remaining narrow strip. After this hoeing, an application of nitrate of soda or manure ploughed in between the rows is given, followed by frequent cultivation.



Renovating an old strawberry patch. The plants are next thinned in the row and the debris is raked up and burned.



Renovating an old strawberry patch. After removing the debris, apply a little nitrate of soda and cultivate it in.

Some growers after narrowing the rows, do the cross-thinning by a harrow or drag, and then finish off with the hoe and cultivator.

In some parts of the Maritimes where plantations fruit for many years and where the rows are a little further apart, the practice is simply to plough between the rows so as to leave a wide furrow, which is filled with manure. A cross-harrowing then covers this furrow with earth. This is followed up with hoeing, hand weeding and cultivating.

#### IRRIGATION

The question of irrigation in most parts of Eastern Canada is rather a difficult one to decide. In the extremely dry sections of British Columbia there is no doubt that irrigation is essential to success, but in the East it is an entirely different question.

At the Experimental Farm, Ottawa, there is an overhead system of irrigation which has been in operation since 1915. The results from this system have not been such as to warrant the unreserved recommendation of its adoption for commercial strawberry-growers.

In the first place the system cost, at the time of installation about \$400 per acre. This figure includes pumping outfit and everything complete for operation. Upkeep has been very light, about \$4 per acre per year, including replacing split pipes, new valves, damage done by teams, cost of cleaning the system in the fall and labour for going over it once a year to tighten up loosened joints, etc. At \$400 original cost this makes an overhead of about \$32 per acre without considering depreciation. If the life of the system is placed at thirty years one would have to write off about \$14 per acre per year which would bring the total overhead to \$46 per acre per annum. Of course a much cheaper but less permanent equipment can be installed. Nevertheless, before adding such a permanent charge the grower should be assured that he will receive enough increased returns to warrant it. The results on the land in Ottawa have not shown that such an outlay would be warranted. The soil is a very light sandy loam and there is always a fair supply of moisture. On drier soils results might have been materially different.

Following are the results for the years 1919-20-22-23, this being the last year comparative notes were kept.

#### YIELDS OF STRAWBERRIES—IRRIGATED AND NON-IRRIGATED:—OTTAWA

Yields per acre in pounds	Irrigated	Not irrigated
1919		
Greenville.....	3,671	4,838
Mariana.....	5,429	4,978
Ophelia.....	2,496	2,730
Pocomoke.....	4,184	6,160
Portia.....	2,987	2,240
Sen. Dunlap.....	1,765	2,006
Splendid.....	5,180	5,973
Average yield per acre.....	25,712	28,925
	3,673	4,132
1920		
Bisel.....	15,487	10,115
Greenville.....	11,395	11,481
Mariana.....	11,290	14,678
Parson.....	7,625	10,431
Pocomoke.....	8,595	8,960
Valeria.....	11,103	14,028
Average yield per acre.....	65,495	69,693
	10,916	11,615

YIELDS OF STRAWBERRIES—IRRIGATED AND NON-IRRIGATED:—OTTAWA—*Con.*

Yields per acre in pounds	Irrigated	Not irrigated
1922		
Cassandra.....	4,683	6,592
Greenville.....	7,176	5,488
Mariana.....	3,321	3,435
Parson.....	4,601	6,087
Portia.....	7,065	4,709
Glen Mary.....	6,011	6,414
Average yield per acre.....	32,857 5,476	32,725 5,456
1923		
Cassandra.....	4,683	6,592
Glen Mary.....	5,058	7,008
Greenville.....	5,230	5,603
Hermia.....	6,730	7,650
Mariana.....	7,590	6,164
Parson.....	5,178	3,947
Portia.....	6,174	8,309
Average yield per acre.....	40,643 5,807	45,273 6,467

## VARIETIES

It occasionally happens that a grower having a variety of strawberry which yields much better with him than other varieties which he has growing alongside, decides to discard all other kinds and grow that one variety. He does so, and is disappointed to find that he has very few berries, and these ill-shaped and worthless. He does not know what to think about it, but writes to the Experimental Farm to learn what is the matter. The reply is sent back: "Are you aware that the flowers of strawberries may be either perfect (bisexual) or pistillate; in other words, do you know that some varieties of strawberries produce blossoms which have both male and female organs, while other varieties have only female organs? If you do not, the solution of your difficulty is very easy."

The male and female organs in plants perform the same functions as in animals. The fine dust formed on the stamens, which is shed when the flower is in bloom, is the fertilizing agent, which falls on the pistil and fertilization takes place. If the stamens are absent, or nearly all absent, as is the case in imperfect or pistillate flowers, no fruit, or very little fruit, is formed. If a perfect (staminate or bisexual flowering variety) and an imperfect flowering variety are growing in close proximity, the flowers of both will be fertilized, as insects and the wind carry the pollen or dust from the perfect to the imperfect flowers. It very often happens that the imperfect flowering varieties produce the best crops when properly pollinated, and this experience may lead fruit-growers who are ignorant of the foregoing fact to make the mistake of planting only one variety, which may be imperfect. While most flowers may be classed as either perfect or imperfect there are gradations between. Occasionally a staminate variety is as imperfect as a pistillate, or more imperfect, as it will not set fruit under any conditions.

A row of a perfect flowering sort should be planted to about every two or three rows of an imperfect variety for good results. The proportion will depend on the amount of pollen produced by the perfect sort. Of course, it is not necessary to plant an imperfect variety at all, as there are plenty of good sorts which have perfect flowers. It is essential to have the perfect and the imperfect varieties in full bloom at the same time, as if the former bloomed before the latter there would be no object in planting it as a pollinator.

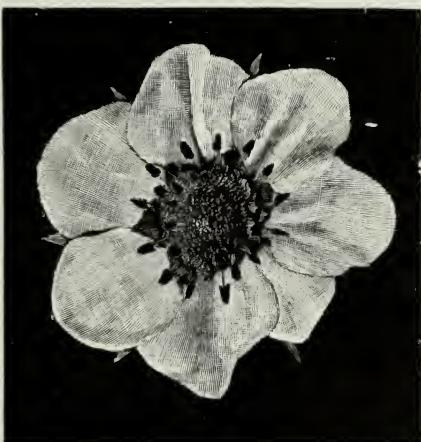
Owing to the ease with which a new variety of strawberry is originated, and the short time it takes to fruit the same, the number of new sorts each year in America is very large. Only a small proportion of those which are produced are better than, or even equal to, the best which are already on the market, but often the originator is not the most competent person to judge the relative value of his seedling, and as a result many sorts are offered for sale each year. It is the work of the Experimental Farms to test these new varieties as they appear, and having compared them with standard sorts, publish, when deemed advisable, a reliable description of them and the yield obtained. During the past thirty years 576 named varieties have been tested at the Central Experimental Farm. Of this number only a very few of those grown during the first two years are still under test. This does not mean that nearly all the varieties tested at first have deteriorated, but that better kinds introduced since have taken their places. In 1926 there were 87 varieties under test.

#### CAUSES OF POORLY-SHAPED BERRIES

There are two causes of poorly-shaped berries or nubbins. The commonest is unfavourable weather conditions. The flower and growing fruit are very susceptible to injury from cold winds or cold weather. Sometimes part of the berry



Imperfect flower.



Perfect flower.

is injured, while another part being perhaps more protected, escapes and develops normally. Another cause of poorly-shaped fruit is faulty pollination. The supply of pollen is either deficient in the fruit itself, or there has not been enough brought by wind and insects to pollinize all the stigmas of the berry. Bees do not work much in bad weather. Extremely dry, hot weather may injure the pollen. Rainy weather during the blossoming season may cause much poorly-shaped fruit by preventing proper pollination. The remedy is to plant varieties with abundant pollen and mix these with any imperfect sorts which may be grown. Keeping the plants back as much as possible in the spring, by not removing the mulch early, will help to avoid injury from cold winds and frosts.

#### SELECTION OF VARIETIES

In addition to considering the sex of the varieties to be planted there are other characteristics of the fruit and plant which the grower should consider in making his selection.

Firmness or ability to hold up and ship well, while not the character generally considered first, should, in the writer's opinion, take first place in

determining the fitness of a variety for commercial use. Too much attention has been paid in the past to yield, with the result that many of our most common varieties are exceedingly bad shippers and reach the market in such poor condition that only in years of great scarcity do they realize anything like profitable prices. Appearance and size are two other considerations of prime importance; yielding ability is also of course a great factor; while hardiness, disease resistance or susceptibility, runner-forming habits, and adaptability to certain soils all have to be given consideration in the final selection. Eating quality, especially for discriminating markets, is of prime importance, and season of ripening has much to do with the final selection of some growers who are catering to special markets where early and late fruit is in special demand.

Probably no fruit is so susceptible to varying soil and climate conditions as the strawberry, so that a variety which does well in one district does not succeed in another close at hand.

In the following lists the varieties are given which in each province are the most popular. Other lists showing the hardiest, earliest, latest, and most disease-resistant sorts are also given.

#### MARITIME PROVINCES

*Commercial*.—Senator Dunlap (per.), for the inland regions; Desdemona (per.), Jessie (per.) for the county of Yarmouth, N.S., and similar coastal areas. These are the main varieties.

*Others grown are*.—Splendid (per.), Glen Mary (per.), Wm. Belt (per.), Sample (per.).

*Domestic*.—Senator Dunlap (per.), Wm. Belt (per.). Recommended for trial: Valeria (per.), Portia (imp.), Parson (per.), Desdemona (per.).

#### QUEBEC

*Commercial*.—Senator Dunlap (per.), Parson (per.), Pocomoke (per.), Portia (imp.), Cassandra (per.).

*Domestic*.—Senator Dunlap (per.), Wm. Belt (per.), Portia (imp.). Recommended for trial: Valeria (per.), Glen Mary (per.), Uncle Jim (per.), Premier (per.).

#### ONTARIO

*Commercial*.—Parson (per.), Glen Mary (per.), Williams (per.), Senator Dunlap (per.), Portia (imp.), Wm. Belt (per.), Cassandra (per.).

*Domestic*.—Senator Dunlap (per.), Parson (per.), Wm. Belt (per.), Portia (imp.), Cassandra (per.). Recommended for trial: Vanguard (per.), Premier (per.).

#### PRAIRIE PROVINCES

Senator Dunlap (per.), Dakota (per.), Beder Wood (per.), Haverland (imp.), Warfield (imp.), Tennessee Prolific (per.).

#### BRITISH COLUMBIA

*Commercial*.—Magoon (per.), Senator Dunlap (per.), Marshall (per.), Plaxton (per.).

*Domestic*.—Royal Sovereign (per.), Marshall (per.), Triomphe de Ghent (per.). Recommended for trial: Glen Mary (per.), Clark Seedling (per.), Heritage (per.), Cassandra (per.), Portia (imp.).

#### HARDEST VARIETIES

There have been some severe winters experienced at the Central Experimental Farm during the past thirty years, which have made it possible to learn which varieties are the hardest. The injury to flowers from frost in the spring is often considerable, as strawberry-flowers are very sensitive to the cold; hence it is important in some districts to know which have the hardest flower-buds. Among the hardest it has been found that the hardiness of the plant is usually correlated with hardiness of flowers, although the late blossoming sorts are less likely to suffer than the early ones. Following are some varieties which have proven hardest: Beder Wood, Lovett, Senator Dunlap, Pocomoke, Crescent, Dakota. The last variety has proved the hardest on the prairies.

## ENGLISH VARIETIES

Many English varieties of strawberries have been tested in Canada, but they have all proved too tender to be grown commercially, or even for home use, except in the mildest parts. The English sorts have been originated in a climate quite different from that in most parts of Canada, hence it is not a matter of great surprise that they are too tender. The best varieties of American origin have to withstand severe winters before they are recognized as valuable for general culture. In Great Britain and Ireland the plants are not subjected to such trying conditions and become popular for other reasons; hence when they are subjected to the frosts of winter and heat and dry weather of summer in Canada, they fail to succeed. As a rule, English and European varieties make few runners and hence are not as well protected by their foliage for extremes of temperature in winter or in summer as the best American sorts. Of those which have been tested, the Champion of England, Noble and Albert appear the hardiest. The best English varieties are better in quality than the best American berries, but some of the most profitable kinds in England are not the best quality. The average variety there, however, is much sweeter and of higher favour than those in Canada; but although the flavour is higher, one misses the sprightliness in some varieties which is characteristic of Canadian strawberries. The Royal Sovereign and the Plaxton are the most popular varieties in British Columbia. Another doing well in British Columbia is Triomphe de Ghent. The Wm. Belt, Marshall, Brunette, and some others compare favourably in quality with the best English sorts, but unfortunately they are not the most productive.

## EARLIEST VARIETIES

Earliness is an important consideration with some growers and a list is here given showing the comparative yields of some of our earliest sorts for the first week of the picking season.

## COMPARATIVE YIELDS OF EARLY VARIETIES

Variety	Yield in pounds 1st crop per 15-ft. row
Excelsior.....	8 — 12
Cassandra.....	7 — 4
Warfield.....	6 — 2
Senator Dunlap.....	5 — 7
Premier.....	5 — 1
Desdemona.....	4 — 11
Greenville.....	4 — 2
Olga Petrova.....	3 — 14
Pocomoke.....	3 — 13
Splendid.....	3 — 6
Mariana.....	3 — 4
Vanguard.....	3 — 3

Excelsior which here leads the list in the amount of fruit produced has for years been the earliest variety tested at Ottawa. While there are others which may show a few odd fruits a day or so earlier none of them have come up in yield for these first few days. It is unfortunate that earliness is about the only recommendation for this variety (see description).

Cassandra, which is a close second, is an enormous cropper of fine large berries better in quality than Excelsior. It cannot be termed a good shipper, however, being too subject to scald. It is perhaps not quite high enough in colour being a pale berry with pale flesh. For a heavy yielding early variety it is hard to beat.

## LATE VARIETIES

Occasionally, growers desire a late variety, one which produces a large part of its crop after the main varieties are over. Among the varieties tested at Ottawa the following are heaviest producers during the last week of the strawberry season.

## COMPARATIVE YIELDS OF LATE VARIETIES

Variety	Yield in pounds per 15-ft. row
Vanilla.....	6 — 3
W. H. Gale.....	5 — 9
Parson.....	5 — 6
Wm. Belt.....	4 — 9
Todd Late.....	4 — 7
Arnout.....	4 — 6
Chesapeake.....	4 — 6
Westney.....	4 — 4
Lavinia.....	4 — 3

Of these Parson and Wm. Belt are the two best known in Canada while Chesapeake is well known in the United States. These three would constitute along with Lavinia for trial the best selection.

## DISEASE-RESISTANT VARIETIES

Elsewhere in the bulletin will be found a treatise on the diseases affecting strawberries so that this paragraph is not designed to cover that phase. In taking our notes, however, note has been made of the varieties which have proved most free of strawberry leaf spot (*Mycosphaerella Fragariae*) and powdery mildew (*Sphaerotheca humuli*).

The varieties found most resistant or free from these diseases are here enumerated.

## VARIETIES FOUND MOST RESISTANT TO LEAF SPOT AT OTTAWA

Ewell Early	Pocomoke
Portia	Kellogg Prize
Excelsior	Splendid
Haverland	Cassandra
Premier	Parson
Warfield	Glen Mary
Senator Dunlap	

Of these varieties while the two best known are at the bottom of the list, nevertheless they are sufficiently free of the disease to be considered commercially resistant under our conditions.

## VARIETIES FOUND TO BE MOST RESISTANT TO MILDEW

Parson	Beder Wood
Senator Dunlap	Excelsior
Pocomoke	Glen Mary
Portia	Splendid
William Belt	

This list includes practically all the well known or commonly grown varieties in Eastern Canada.

### EVERBEARING STRAWBERRIES

During the past twenty to twenty-five years, but particularly during the past six or eight years, there has been much interest shown in the so-called "ever-bearing" strawberries. These are varieties which continue to bloom and ripen fruit during the summer and autumn long after other kinds have stopped bearing. This everbearing habit is considered by some botanists to be due to the transformation of the runners of these varieties into flower-bearing stems, the everbearing sorts making few runners. The wild Wood strawberry and its variety, the Alpine, have long been known to fruit more or less all through the summer and autumn, and for this reason they, and several cultivated varieties of them, are often called the "Strawberries of Four Seasons." These all bear small fruit, hence they have little commercial value at present. In 1890, the Oregon Everbearing strawberry was exhibited at the Portland Exhibition and attracted much attention, being of good size. Whatever its everbearing habits may have been in Oregon, it proved very disappointing in this respect when brought to the Eastern and Middle States and to Canada. It was introduced into France about 1893 or 1894, and was highly thought of there for some time, as its everbearing habit was quite pronounced.

In 1893, the St. Joseph strawberry was introduced in France and its introduction marked a new epoch in the history of everbearing strawberries. This variety was the result of thirteen years' work by the Abbé Thivolet, Clanoves, Francee, who began in 1880 by crossing the Alpine strawberry with a large-fruited variety, the latter being the female parent. From this cross is supposed to have sprung the St. Joseph, through many generations and selections. In it there is no evidence of Alpine blood. While the St. Joseph strawberry was much larger than the Alpines, which up to its advent were the only cultivated strawberries which showed the everbearing habit regularly, they were small compared with some of the best large-fruited sorts. Seedlings were raised from the St. Joseph in France; the St. Antoine de Padoue, being one of the best of them. The Oregon Everbearing strawberry was planted at the Central Experimental Farm in 1895 and the St. Joseph in 1899, but neither of these varieties produced enough fruit after the regular strawberry season was over to make them worth cultivating.

The second American everbearing variety which attracted attention was the Pan American, which was shown at the Pan American Exhibition in Buffalo in 1900. The parent plant was discovered in the autumn of 1898 by Mr. Samuel Cooper, of New York state, in a field of the Bismarck variety, his attention being drawn to it on account of its having fruit in the autumn. From this variety, and through Mr. Cooper, several have been developed; among them are the Autumn, Productive, Superb, Peerless, Onward, Forward, Advance; but none of these have so far become as popular as those which have been originated by Mr. Harlow Rockhill, Conrad, Iowa, who used as one parent the Louis Gauthier, one of the best of the European everbearing sorts. Some of his varieties are crosses between it and the Pan American, although the Progressive which until recently had done best at Ottawa, is a cross between the Senator Dunlap and the Pan American. Some of the best of Mr. Rockhill's introductions are Progressive, Americus, Francis, Iowa, and Rockhill, the last named being considered an outstanding acquisition.

The Minnesota Plant Breeding Station has done considerable work in breeding these everbearing varieties, and one of the best which has been introduced is the No. 1017, now called Duluth.

Among the more recent introductions is Rockhill referred to above, which although not having fruited with us is well spoken of by Darrow of the United States Department of Agriculture.

Champion is also a fairly new introduction and Leslie of the Morden Experimental Station considers it very promising. This variety has not done as well at Ottawa as Duluth (formerly Minn. 1017). Of the commercial sorts tried here Duluth is still considerably in the lead, taking yield and size of fruit into consideration.

Mastodon is perhaps, the most popular everbearing variety.

The everbearing varieties differ from the June-bearing sorts in that they not only bear a crop in the regular fruiting season, but shortly after that season is over they produce a second crop of fruit and continue blooming in many instances right up until frost.

The older introductions were very poor plant-makers, but Duluth, Champion and Rockhill are improvements in this connection.

To date our experience has not led us to consider these as a commercial possibility, as both the June yields and the fall yields are below those to be expected from a good bearing sort. If the fall price is sufficiently high, how-



Picking "Champion" strawberries, October, 1925, Morden, Man.

ever, a grower might be warranted in planting an area of these sorts. In a following paragraph will be found a comparison of their yield with those of the June bearing sorts.

At the Experimental Farm, Ottawa, a considerable amount of breeding work has been done with everbearers and at present several very promising new hybrids are under propagation for further trial. These hybrids are larger fruiters than any we have yet seen and much better plant-makers. In addition many of them come in sufficiently early after the main crop to have an opportunity of ripening their fruit before frost. A plantation of everbearers should be handled in a somewhat different manner than a plantation of June bearers.

Sometimes it is expected that the everbearers will produce a full crop in June and follow with another crop in the fall. Our experience indicates that better results are obtained by taking a crop in the fall of the planting year, and a June crop in the following season. With this in view and considering that these do not make as many runners as the June sorts, the planting scheme is modified somewhat.

In the first place if planted in the early fall or late autumn there are not only earlier rooted stolons but more plants for the first fall crop; and secondly, if planted closer together than is ordinarily recommended for June sorts, much greater returns per acre are secured. Planting in double rows 3 feet apart from centre to centre is sufficiently far apart. The two rows constituting the double rows may be 1 foot apart, with the plants 1 foot apart in each row, but placed so that they are alternate instead of opposite. This is close planting, but sufficiently far apart for any varieties we have tested that are worth growing.

As the fall bearer is forming fruit-buds during early summer or shortly after rooting for the fall crop, it is imperative for best results to have an available supply of plant-food, especially nitrogen. An application of nitrate of soda made in June in soils not overstocked with nitrogen will give good results in this respect.

#### COMPARATIVE YIELDS FROM EVERBEARING SORTS AND A FEW OF THE BEST JUNE-BEARING VARIETIES

In the following table is given the June yield and fall yield from some of the best everbearing sorts tried at Ottawa, and for the sake of comparison the yields of three well-known June varieties are also attached. The yields are given in terms of pounds per acre, these having been calculated from the plot records.

#### COMPARISON OF TOTAL YIELD BETWEEN THREE EVERBEARERS AND THREE JUNE BEARERS

	1917				1920				1923			
	Plot		Acre		Plot		Acre		Plot		Acre	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
<i>Everbearers</i>												
Duluth (Minn. 1017).....	5	11	4,285	6	23	2½	9,606	8	32	6½	9,410	12
Progressive.....	5	3½	4,330	1	15	14½	6,592	4	14	9	8,547	14
Superb.....	1	½	777	14	18	6	7,623	0	16	10	4,827	14
<i>June bearers</i>												
Sen. Dunlap.....	7	5	4,044	14	16	8	6,845	2	40	14	11,870	2
Pocomoke.....	37	11	4,598	8	21	5½	8,854	9	34	9	9,873	10
Parson.....	18	14½	7,843	6	29	5	12,161	7	33	14	9,837	5

#### FALL YIELDS IN 1925 OF SOME NAMED EVERBEARINGERS AND SOME C.E.F. HYBRIDS. (1st YEAR)

	Lb.
20, 80, 38 C.E.F.....	3,720
20, 62, 21, C.E.F.....	3,297
20, 25, 47, C.E.F.....	2,964
20, 25, 03, C.E.F.....	2,238
Minn. 1017 (Duluth).....	2,087
Champion.....	1,815

Progressive, Americus and Superb had been discarded for low yields so do not appear here, while Rockhill and Mastodon had not become established at this date.

### DESCRIPTIONS OF VARIETIES

Following are descriptions of the principal varieties of strawberries grown in Canada, and of some others that have yielded very well at the Central Experimental Farm and which should be tested by growers for comparison with those they are accustomed to plant. Some of the oldest varieties continue to be the most productive. The Senator Dunlap, however, is the most popular variety in Canada, and this is of more recent introduction than some of the others. Nearly all of these descriptions were made by the authors from the variety as grown at the Central Experimental Farm, Ottawa. The information in regard to the origin of a number of the varieties was obtained from Technical Bulletin 11 of the Virginia Agricultural Experiment Station by S. W. Fletcher:—

*Aroma* (per.)—Orig. 1889, E. W. Cruse, Leavenworth, Kansas, seedling of Cumberland Triumph; introd. 1892. This is the dominant variety of Missouri which so often finds its way on our markets in the early summer. A remarkable shipper. Has not proved adapted to Ontario conditions. Large size; uniform; round conic; bright scarlet; seeds fairly prominent. Quality good.

*Arnout* (per.)—Orig. J. L. Arnout, Luzerne county, Pa.; introd. 1905. Large-sized fruit of bright glossy colour, with prominent seeds and bright-red flesh. A fairly firm, somewhat wedge-shaped fruit of good appearance. Vigorous foliage. One of the best of the later sorts. Not widely grown in Canada.

*Beder Wood* (per.)—An old variety originated at Beder Wood, Moline, Ill.; introd. 1890 as Raester, and in 1891 as Beder Wood. A medium-sized, pale-red fruit, rather roundish-conical in shape; seeds somewhat sunken. Fruit moderately firm, and of fair quality. A very early variety. Valuable for earliness and is productive when not too badly rusted. Discarded from C.E.F. 1925 on account of rust.

*Bisel* (imp.)—Seedling of Wilson. Orig. 1887, D. L. Bisel, Southern Illinois; introd. 1893 as Dan Bisel. A handsome bright-red sort, inclined to hollowness. Only a moderately firm berry. Another one subject to rust and discarded on that account.

*Brandywine* (per.)—Chance seedling, supposed cross between Glendale and Cumberland Triumph. Orig. 1889, E. T. Ingram, Westchester, Pa.; introd. 1895. Fruit roundish to sugar-loafed; above medium to large, deep, dull red; seeds not prominent; flesh bright red, juicy, firm; briskly subacid; quality good; season late; plant vigorous; runners moderately numerous; foliage moderately good to good; rusts slightly to considerably. While not as productive as some, it is a good variety for home use because of its quality and lateness.

*Bubach* (imp.)—Orig. 1882, J. G. Bubach, Princeton, Ill.; introd. 1886. Irregular wedge-conical, very large, bright red; seeds not prominent; flesh bright red, juicy; subacid, moderately firm to firm; good quality; season medium to late; plant vigorous, runners medium in number; foliage moderately good, but rusts slightly to considerably.

*Charles I* (per.)—Orig. 1907, Geo. Mann, Bridgeman, Mich.; introd. 1911. An early variety thought well of by some growers. Discarded from C.E.F. as being too soft for commercial purposes.

*Chesapeake* (per.)—Although this variety is well known in the New England States it has never been at all outstanding under Ottawa conditions. (Chance seedling). Orig. 1903, Geo. W. Parks, Nanticoke Point, Md.; introd. 1906. Fruit roundish-conical, large, bright red; flesh red, firm; subacid; good quality; season medium late; plant vigorous, runners moderately numerous. Has succeeded well in some places.

*Clark* (per.)—Thought to be a seedling of Wilson. Orig. Fred. E. Clark, near Portland, Oregon; introd. about 1880. Succeeds best in the irrigated districts; needs much moisture. A very firm berry, and good for shipping. Grown considerably in the Maritimes.

*Clyde* (per.)—Another variety discarded at Ottawa largely on account of rust. Seedling of Cyclone. Orig. J. Stayman, Leavenworth, Kansas; introd. about 1890. Fruit roundish, large to very large, pale red; seeds not prominent; flesh pale red, juicy, firm; subacid, pleasant; quality above medium; season medium early; plant vigorous, runners numerous; foliage poor to moderately good, liable to rust considerably; often productive but suffers from scalding in a dry time owing to lack of foliage.

*Dakota* (per.)—Jessie x wild strawberry of Manitoba. Orig. N. E. Hansen, Brookings, South Dakota. Fruit below medium to small; bright red; quality above medium; runners very numerous. This variety has proved hardier than any other variety tested at the Experimental Stations on the prairies.

*Desdemona* (imp.)—Bubach seedling. Orig. 1906. Horticultural Division, Experimental Farm, Ottawa, Ont.; introd. 1913. Form conical to wedge-conical; size medium to large; external colour bright deep red, glossy; colour of flesh deep red; seeds medium; core tender; texture juicy; flavour briskly subacid, pleasant; quality above medium to good; season medium to late; shipping quality moderately firm to firm; plant vigorous, productive; foliage good. A good berry for home use and commercial.

*Dunlap* (Senator Dunlap) (per.)—Parentage uncertain. Orig. 1890. J. R. Reasoner, Urbana, Ill.; introd. 1900. Fruit pointed, wedge and long wedge-conical, necked, medium to large size, deep glossy red; seeds not especially prominent; flesh rich red, juicy, tender; briskly subacid; moderately firm; above medium quality; season early; plants vigorous, large number of runners; foliage moderately good, rusts considerable in old beds. The most generally popular variety. This variety is more suitable to heavy soils. Being a heavy runner-maker it should be planted far apart in rows. Although very popular it is not of great merit at Ottawa, producing only about three pickings of good size, going off almost at once to very small berries.

*Excelsior* (per.)—Wilson x Hoffman. Orig. 1892. Louis Hubach, Judsonia, Ark.; introd. 1897. Fruit roundish-conical, medium to above medium in size, deep glossy red; seed not prominent; flesh bright red, juicy, firm; briskly subacid; medium quality; season early to extra early; plant vigorous, runners numerous; foliage good but occasionally rusts considerably. A persistently early variety.

*Jessie* (per.)—Orig. 1880. F. W. Loudon, Jamesville, Wisconsin, Sharpless x Miner's Prolific. Introd. 1886. An old variety grown in the southern U.S.A. also on the Pacific coast of the U.S.A. Requires high culture and a moist climate. Does well and sometimes better in the second and third crops. Large size, pale colour, and almost white flesh. A good shipper. Largely grown in southern Nova Scotia.

*Glen Mary* (per.)—This variety has been very popular in Ontario but in our opinion undeservedly. It has a rather poor appearance with its pale tips, and is certainly not a good shipper. Orig. J. A. Ingram, East Bradford, Pa.; introd. 1896. Fruit irregular, roundish to wedge-conical, very large to large, deep red at base becoming pale towards tip; seeds not prominent; flesh, bright red, juicy, rather watery, firm; subacid; medium quality; medium season; moderately vigorous, runners numerous; foliage moderately good to good, sometimes rust considerably; not a very good pollenizer. One of the most popular commercial varieties.

*Greenville* (imp.)—This old standby nearly always gives a good crop, but is unfortunately too soft for commerce. Chance seedling. Orig. 1883, E. M. Buechly, Greenville, Ohio; introd. 1893. Fruit roundish to wedge-shaped, large to very large, bright red; flesh bright red, juicy, moderately firm to rather soft; subacid, pleasant; good quality; plant vigorous, runners numerous; foliage good, rusts slightly to considerably.

*Haverland* (imp.)—Crescent x Sharpless. Orig. 1882, B. H. Haverland, Cincinnati, Ohio; introd. 1887. Fruit irregular, long-pointed, wedge-conical and roundish, above medium in size; bright, but rather pale red; rather prominent seeds; flesh pale red, juicy, moderately firm; subacid; above medium in quality; season medium early; plant vigorous, making a moderate number of runners; foliage moderately good, occasionally rusts considerably. Rather too pale in colour, but although introduced more than thirty years ago, still succeeds well in some places.

*Heritage* (per.)—Barton x Marshall. Orig. 1902. J. E. Heritage, Marlton, N.J.; introd. 1906. Fruit wedge-shaped, large, bright red, glossy; seeds moderately prominent; flesh bright red; tender, moderately juicy, sometimes hollow in centre, moderately firm; subacid, pleasant; quality good; season medium; plant vigorous, runners moderately numerous; foliage good. A large handsome berry. Especially promising for home use.

*Howard (17)* (per.)—Orig. A. B. Howard, Belchertown, Mass.; introd. about 1909. Fruit large, long, conical to somewhat wedge-shaped, large, bright scarlet; flesh light red, moderately firm; quality good; season medium early; plant vigorous, runners numerous. This variety is thought much of by growers. The same as Premier.

*Magoon* (per.)—Chance seedling. Orig. W. J. Magoon, Portland, Oregon; introd. 1894. Fruit roundish, somewhat irregular, medium to large, deep red; flesh deep red, moderately firm; subacid; good quality; season medium to late; plant very vigorous, runners only moderately numerous. A popular variety in British Columbia. Has not proved of value at Ottawa.

*Marshall* (per.)—Chance seedling. Orig. 1890, Marshall F. Ewell, Marshfield Hills, Mass.; introd. 1893. Fruit pointed-conical to roundish, large to very large, dark red; rather conspicuous seeds; flesh bright red, juicy, firm; subacid, good flavour; very good quality; season medium; plant moderately vigorous, runners moderately numerous; foliage good though rusting slightly to considerably. Productive only where heavily fertilized and where there is abundance of moisture. One of the tenderest American varieties, but one of the best in quality.

*New Globe* (per.)—Orig. 1898, Eugene Sutherland; introd. 1901. Fruit obtusely conical to roundish, dull, rather pale red; seeds moderately prominent; flesh bright red, juicy, firm; briskly subacid to acid, pleasant flavour; quality medium to good; season medium to late; plant vigorous; foliage good. This has proved to be one of the most productive varieties at Ottawa, but is so soft that it has been discarded.

*Ozark* (Early Ozark) (per.)—Orig. 1902, Chas. Shull, Sarcoxie, Mo. Fruit roundish conical, medium to large, dark red; flesh deep red, firm; subacid; good quality; season early; runners numerous. This has proved a profitable early variety in some places.

*Parson* (Parson's Beauty) (per.)—Chance seedling. Orig. about 1895, R. G. Parsons, Parsonburg, Md.; introd. 1899. Fruit obtusely conical, above medium to large in size, bright red, glossy; prominent seeds; flesh bright red, juicy, tender, firm; subacid; above medium quality; season medium late; plant vigor-

ous, large number of runners; foliage moderately good, rusts slightly to considerably. Productive only where heavily fertilized and where there is abundance of moisture. One of the tenderest American varieties, but one of the best in quality.

*Paxton* (per.)—This English variety succeeds well in Vancouver island and is one of the most popular varieties there. The fruit is large, deep red with green tip, ovate, pointed. It is very sweet and good in quality. The plant makes a moderate number of runners. Has not proved of value at Ottawa.

*Pocomoke* (per.)—Chance seedling. Orig. E. H. Hamblin, Pittsville, Md.; introd. about 1902. Fruit obtusely conical, large to very large, bright glossy red inclined to have white tips; seeds rather prominent; flesh bright red, juicy, tender, very firm; briskly subacid; above medium quality; season medium late; plant vigorous, large number of runners; foliage moderately good, sometimes rusts considerably to badly in old plantations. Not liable to become popular on account of white tips.

*Royal Sovereign* (per.)—One of the best all-round English varieties. It is of excellent quality and is highly regarded for home use in British Columbia. The fruit is of large size and bright red in colour. The plants make many runners. Of no value at Ottawa.

*Sample* (imp.)—Chance seedling in old bed of Leader. Orig. 1894, J. V. Gowing, N. Reading, Mass.; introd. 1898. Fruit pointed-conical, very regular in shape; above medium to large; bright or rather deep glossy red; seeds fairly prominent; flesh bright red, juicy, almost watery, moderately firm; subacid; medium quality; season medium to late; plants vigorous, large number of runners; foliage moderately good to good, rusts considerably. A handsome berry. Mildews badly in some seasons.

*Sharpless* (per.)—Supposed seedling of Chas. Downing. Orig. 1872, J. K. Sharpless, Catawissa, Pa.; introd. 1877. Fruit irregular, wedge-conical, large, bright red, seeds prominent; flesh juicy, moderately firm; subacid, good quality; season medium to late; plant very vigorous, runners only moderately numerous. This is one of the oldest varieties grown in Canada, but it is still highly regarded in British Columbia.

*Splendid* (per.)—Orig. C. H. Sumner, Sterling, Ill; introd. about 1892. Fruit roundish, medium to large, deep red; seeds not prominent; flesh red, juicy, moderately firm; acid; above medium quality; early to medium season; plants vigorous, numerous runners; foliage moderately good, rusts considerably to badly only in old plantations.

*Triomphe de Ghent* (per.)—A European variety which is regarded highly for home use on Vancouver island. The fruit is large, wedge-shaped, red in colour and is very sweet and of good flavour. The plant makes many runners.

*Tennessee* (Tennessee Prolific) (per.)—Crescent x Sharpless. Orig. J. C. Hodges, East Tennessee; introd. about 1892. Fruit wedge-shaped, flattened, rather irregular, large, bright red, glossy; seeds not prominent; flesh bright red, juicy, moderately firm; subacid; above medium in quality; season medium late; plant vigorous; runners numerous; foliage moderately good to good, rusts slightly. A very attractive productive variety which has done particularly well at the Experimental Station, Lethbridge, Alta.

*Uncle Jim* (per.)—Chance seedling. Orig. 1898, J. F. Dorman, Glenn, Mich.; introd. 1902. Fruit roundish to obtusely conical, large bright red; seeds not prominent; flesh bright red, juicy, to moderately firm; subacid, good flavour, good quality; season medium late to late; plant vigorous, runners only moderately numerous; foliage good. Does well under high cultivation.

*Warfield (No. 2)* (imp.)—Chance seedling; thought Crescent x Wilson. Orig. about 1882, C. B. Warfield, Sandoval, Ill.; introd. 1885. Fruit pointed, conical, medium to above medium size, deep red, glossy; rather prominent seeds; flesh deep red, juicy, moderately firm; acid; medium quality; early to medium season; plants vigorous, large number of runners; foliage moderately good, rusts considerably in old beds. A handsome berry and a good cropper, but needs abundance of moisture.

*Williams* (per.)—Crescent x Sharpless. Orig. Mr. Williams, Burford, Ont.; introd. 1891. Fruit wedge-conical, large, bright, rather deep red with a white tip; rather prominent seeds; flesh bright red, juicy, firm; subacid, good flavour; quality good; medium season; plants vigorous, large number of runners; foliage moderately good, but considerable rust. Popular in some parts of Ontario.

*Wm. Belt* (per.)—Orig. about 1888, Wm. Belt, Mechanicsburg, Ohio; introd. 1896. Fruit irregular, first fruit wedge-shaped, others wedge and pointed-conical, large, bright red; seeds fairly prominent; flesh bright red, meaty, juicy, firm; subacid, good flavour; very good quality; season late; plants vigorous, with a large number of runners; foliage moderately good to good, but rusts considerably to badly. One of the best for home use and for local markets where a high quality fruit is demanded.

#### PROMISING VARIETIES ORIGINATED AT THE CENTRAL EXPERIMENTAL FARM, OTTAWA

Some very good varieties of strawberries were raised from seed of the Bubach and Wm. Belt in the Horticultural Division at Ottawa. They have been tested at Ottawa and other places for a number of years, and some of the best of them are here described. All of these except Bianca and Lavinia were described in the Annual Report of the Horticultural Division for 1913. These are all named after Shakespeare's heroines.

Of this lot many have fallen by the wayside and a few are still in doubt. Following is a description of those that are still left, together with a note as to their possible value.

*Cassandra* (imp.)—Bubach seedling. Orig. 1906, Horticultural Division, Experimental Farm, Ottawa, Ont.; introd. 1913. Form roundish, wedge-shaped, regular; size large; external colour bright scarlet, glossy; colour of flesh deep salmon; core tender; texture juicy; flavour briskly subacid, pleasant, quality above medium to good; season medium to late; shipping quality moderately firm; plant vigorous; foliage good; a handsome variety of good size, form and colour; productive. Has proved to be a very productive sort, but has a tendency to seald, rendering it less valuable for shipment. Not a good canner. A very valuable early berry, retains its size excellently.

*Desdemona* (imp.)—Bubach seedling. Orig. 1906, Horticultural Division, Experimental Farm, Ottawa, Ont.; introd. 1913. Form conical to wedge-conical; size medium to large; external colour dark red; colour of flesh dark red; seeds medium; core solid but tender; texture juicy; flavour briskly subacid, pleasant; quality above medium to good; season medium to late; shipping quality moderately firm to firm; plant vigorous, productive; foliage good. A good berry for home use and commerce. This is one of the doubtful ones. It has many good points which makes one loth to part with it, being moderately early and a very handsome berry especially good for canning.

*Hermia* (per.)—Wm. Belt seedling. Orig. 1906, Horticultural Division, Experimental Farm, Ottawa, Ont.; introd. 1913. Form conical to wedge-conical; size medium to large; external colour bright deep red, glossy; colour of flesh deep red; seeds medium; core tender; texture juicy; flavour subacid, good; quality good; season medium; shipping quality firm; plant vigorous, productive; foliage good. A good berry, attractive in appearance.

*Lavinia* (per.)—Wm. Belt seedling. Orig. 1906, Horticultural Division, Experimental Farm, Ottawa, Ont.; introd. 1919. Fruit wedge-conical to wedge-shaped and roundish conical, large; deep, rather dull, red; seeds moderately prominent; flesh bright red, tender, firm to moderately firm; briskly subacid; quality above medium; season medium late; plant vigorous; runner numerous; foliage good. While not so good in quality as some others, it has proved very productive. This resembles Parson and has proved a very heavy cropper, and fairly good shipper.

*Mariana* (per.)—Bubach seedling. Orig. 1906, Horticultural Division, Experimental Farm, Ottawa, Ont.; introd. 1913. Form wedge-shaped to roundish wedge-shaped; size large; external colour bright deep scarlet, glossy; colour of flesh deep salmon; seed medium to medium late; shipping quality moderately firm; plant vigorous, productive; foliage good; of good size and attractive appearance. Good for home market. This is another of the doubtful ones, not being outstanding as a yielder and a little too soft for shipping purposes.

*Portia* (imp.)—Wm. Belt seedling. Orig. 1906. Horticultural Division, Experimental Farm, Ottawa, Ont.; introduced 1913. Form roundish conical to wedge-conical; size large, external colour deep red, glossy; colour of flesh deep rich red; seeds very prominent; core tender; texture juicy; flavour briskly subacid, pleasant; quality good; season medium late to late; shipping quality firm; plant vigorous; foliage good. A late berry of good form and colour. In many respects Portia is the finest berry we have ever grown. It is exceptionally uniform, very handsome and has that desirable dark flesh for canning. On heavier soils it yields well and being a good shipper if picked at the proper time, should be a valuable acquisition.

#### VARIETIES OF RECENT INTRODUCTION

In addition to the varieties already enumerated, there have been a number of varieties introduced in recent years, some of which have been grown at the Central Experimental Farm long enough to give an opinion as to their merit under our conditions.

*Beacon* (per.)—Orig. N.Y. Experimental Station, Geneva, N.Y. About the season of Dunlap. Quality good, appearance good; size large, somewhat wedge-shaped. Said to be productive but has not proved so during the one year it has been at Ottawa, may show up better in later years. Its greatest asset is its handsome appearance being very lustrous, almost as if varnished.

*Boquet* (per.)—Another introduction of the N.Y. Experimental Station. Large roundish fruit, very glossy dark red in colour, with a few white tips. Flesh is dark red, a very desirable quality, mild in flavour and good in quality. Appears to be very promising so far. Its greatest objection is that it is a little rough in shape. Season, about main crop. Worthy of extended trial.

*Big Late* (per.)—Introduced by Kellogg. A long, pointed, cone-shaped berry, of large size. Very dark in colour with dark flesh; poor flavour, and poor quality; too soft for shipping. Promising for size, appearance and productivity but too poor in quality and too soft.

*Dr. Burrill* (per.)—Introd. by Kellogg. Not a very new variety, but of comparatively recent origin. Very much like Dunlap, in fact almost impossible to distinguish from that variety. We have been unable to see any advantage in this variety over that of Dunlap.

*Delicious* (per.)—Introd. by Kellogg. Delicious has been one of those remarkable-appearing fruits that has been a keen disappointment when it comes to yield. A very large, oblong wedge, with glossy bright crimson colour and fairly dark red flesh; quality good. A very handsome berry, does not make runners under our conditions and has not proved productive. Worth a small trial on other soils.

*F. E. Willard* (per.)—Obtained by us from H. L. McConnell, Port Burwell, Ontario. A fairly shapely berry of rather rough appearance. Late in season; only moderately productive. Too subject to mildew to be desirable. Has one outstanding virtue and that is its firmness for shipping. A good plant-maker. Quality is good.

*Ford* (per.)—A roundish wedge-shaped berry, rather rough in appearance; good size; dark crimson colour, with prominent seeds. Flesh is a dark salmon. Rather acid and only moderate in quality. Inclines to green tips. Not promising.

*Grand Prize* (per.)—Introd. by H. L. McConnell of Port Burwell, Ont. Very similar to Parson. Has given good yields in some seasons, but appears to be very subject to mosaic which has eliminated it from our plantations. Mostly wedge-shaped fruit, slightly necked; good quality and size. A good runner-maker. No improvement over Parson.

*Great Northern* (imp.)—An introduction of Kellogg that has not done well at Ottawa. Large size; bright scarlet with salmon flesh. Too soft for commercial use, and not outstanding in any respect.

*Kellogg Prize* (imp.)—Introd. by R. M. Kellogg. Said to be a chance seedling. A late variety, of good size; light red, with light red flesh, vigorous and a good runner-maker. Apparently a good shipper. While not very productive at Ottawa, worth a trial under other conditions.

*Marvel* (per.)—Introduction of Kellogg. A below-medium-size, necked, conical berry, with white tips and unattractive colour. Very subject to mildew. Not at all promising at Ottawa.

*Olga Petrova* (per.)—Introd. by C. B. Stevenson, Guelph, Ont. A medium-to small-sized berry; rather dull scarlet colour with bright scarlet flesh; seeds very sunken; quality poor; too soft for commerce. A good runner-maker but not promising.

*Premier* (per.)—Another introduction from Kellogg. A short conic wedge; size rather on the small side; bright scarlet with deep salmon flesh; quality medium; fairly firm. Too small and not productive enough at Ottawa. The same as Howard 17. Very popular in other places.

*W. H. Gale* (per.)—A large-sized, rough fan-shaped berry, similar to Wm. Belt; good quality; probably a fair shipper. Appears promising as a late berry.

*Willard* (per.)—Probably the same as Francis Willard, introduced by the Crawford Company. A very handsome berry; strongly necked and of long shape; large size and very attractive; rather dry and lacking in flavour; appears to be an excellent shipper. Worth an extended trial, being one of the most handsome berries grown.

*Westney* (per.)—An angular conic-shaped berry, of large size, colour a bright scarlet with salmon flesh; prominent seeds; flavour rather acid; medium to below in quality; apparently a good shipper. Resembles Pocomoke somewhat. While not outstanding, has proved an excellent parent in breeding work.

*Vanguard* (per.)—A new early berry possessing good shipping qualities and good colour. Not as heavy in early yield as Cassandra at Ottawa, but promising. The following description from the Experimental Station, Vineland, Ontario (the originator), is appended: "This variety is a cross of Pocomoke and Early Ozark. It is a good, though not an excessive plant-maker. Plants are vigorous, healthy and productive. Flowers are perfect. In season it is early, ripening about one week before Dunlap. Fruit is of medium size, round conic, regular in shape, colour bright red, quality good, sweeter than most early varieties. The berries are firm and should ship well. The fruit holds its size well throughout the season, the late pickings being of good size."

## NEWER VARIETIES UNDER TRIAL\*

Easy Picker—Introduced by the Minnesota Fruit Breeding Farm.  
 Large—From W. H. Etter, Ettersburg, California.  
 Bliss—An introduction from the New York Experimental Station, Geneva.  
 Bun Special—From H. L. McConnell, Port Burwell, Ontario.  
 Chaska—Introduction of Minnesota Fruit Breeding Farm.  
 King Wealthy—From C. W. Potter, Leslie, Michigan.  
 Minnehaha—Introduction from the Minnesota Fruit Breeding Farm.  
 Given's Late—An introduction from Thos. Rivers, England.  
 H.E.S. No. 1—An introduction from the Experimental Station, Vineland, Ontario.  
 King George V—A notable introduction from Thos. Rivers, England.  
 Elgin—An introduction from H. L. McConnell, Port Burwell, Ontario.  
 Mastodon—A new everbearing variety from Emlong, of Michigan.

## COST OF GROWING STRAWBERRIES

## MATTED-ROW SYSTEM

Ordinarily the strawberry is one of the most profitable fruits to grow, but at the same time it is one of the most expensive. The initial outlay, however, is not large and as returns may be obtained one year after planting it is a proposition which should appeal to many.

In order that some figures showing the cost of growing strawberries might be available to prospective growers, a letter was sent to strawberry-growers in different parts of Canada asking for estimates of what it cost them to grow this fruit. Relatively few of those who were asked for this information had kept an account of the cost, or could make an estimate of it, but we desire to thank those who were able to furnish this useful information. The plots at the Experimental Farms and Stations are not large enough to make a fair estimate of the cost of growing by the acre.

## COST OF GROWING AN ACRE OF STRAWBERRIES: MATTED-ROW SYSTEM

—	1	2	3	4	5
	\$	\$	\$	\$	\$
Rent of land.....	28 00	12 00	10 00	25 00	50 00
Net in operating expenses.....					10 00
Preparation of soil.....	5 00	10 00	15 00	15 00	17 50
Fertilizers.....	40 00	36 85	45 00	75 00	50 00
Plants.....	28 00	40 00	35 00	25 00	24 50
Planting.....	12 00	13 50	10 00	8 00	10 50
Cultivation.....	30 00	95 14	30 00	50 00	35 00
Mulching.....	24 00	20 00	20 00	35 00	25 00
Crates.....	37 00	62 64	33 00	50 00	40 00
Boxes.....	37 00	45 50	40 00	50 00	24 00
Picking.....	125 00	138 60	100 00	100 00	100 00
Marketing.....	40 00	43 35	30 00	10 00	75 00
Insects and diseases.....					
Total.....	406 00	517 58	358 00	443 00	451 50
Crop in quart boxes.....	5,000	6,930	4,000	6,000	4,000
Average cost per quart box.....	8·1c.	7·5c.	8·9c.	7·4c.	11·4c.
Average price.....		17c.	12-15c.		20c.

- No. 1. H. E. Dewar, Charlottetown, P.E.I.  
 No. 2. P. J. Shaw, Agricultural College, Truro, N.S.  
 No. 3. M. L. Ells, Port Williams, N.S.  
 No. 4. Jas. Johnson, Simcoe, Ont.  
 No. 5. Prof. T. G. Bunting, Macdonald College, P.O.

\*Will be reported upon in the Annual Reports of the Horticultural Division.

The figures of the growers differ considerably, as is to be expected, as conditions vary so much in different parts of Canada. Different kinds of soil also require different treatment, and the distance from the point of shipment or market makes a difference in the cost of marketing. Rent of land varies considerably, it being much higher near cities. In one case the cost of cultivation is very high. Where such weeds as chickweed become established, or other weeds requiring much hand work, the cost of cultivation will be very high. Prospective growers should remember that to keep down expenses it is important to have clean land, and manure and straw for mulching as free from weeds as possible, and to plant so as to do as much work with the cultivator as possible. There is a great deal of difference in the cost of the fertilizer used. Good soils do not need as much as the poorer ones.

It will be noted that the cost per box ranges from  $7\frac{1}{2}$  cents to  $11\frac{1}{4}$  cents, which latter figure is largely due to high land-values and marketing costs, the fruit in this case being mostly retailed by the producer. The other costs are very close, and represent a fairly true average of what might be considered the average cost of production per quart box (full quart). Wherever the price has been greater there is shown a comfortable margin ranging from around  $3\frac{1}{4}$  cents to  $9\frac{1}{2}$  cents, or on the basis of the acreage yields recorded in each case, a net profit per acre of from \$130 to \$658.

If the fruit is sold to a canning-factory the cost of crates and boxes can be saved, reducing the cost of production by about \$100 per acre. Thus the canners' price, although about 2 cents a box lower, approximates the commission house price in value.

While the yields here recorded do not in any case exceed 7,000 quarts per acre, it is not uncommon to have yields of over 8,000 quarts and occasionally as high as 10,000 quarts. These are phenomenal yields and the average from year to year more closely approximates 4,000 to 5,000 quarts.

#### COST OF PRODUCTION IN BRITISH COLUMBIA—HILL SYSTEM

According to the information contained in Circular No. 39, British Columbia Department of Agriculture, the average cost of producing strawberries for a three-year cycle (two berry years and one plant-making year) ranges from \$993.94 to \$1,251 per acre, or from less than 6 cents a pound to slightly over 9 cents a pound. These figures are not substantially different from the cost of production in Eastern Canada, where the matted row is used.

## INSECTS AFFECTING THE STRAWBERRY\*

BY THE ENTOMOLOGICAL BRANCH, DEPARTMENT OF AGRICULTURE

## GENERAL RECOMMENDATIONS

(1) In selecting a site for the plantation, keep as far away as possible from woodlots, rough land, old fences, and all similar spots likely to give shelter to insects during the winter.

(2) It is seldom advisable to set out a plantation on land which has been in sod. Such land is likely to be infested with white grubs, which are sure to attack the strawberries, when deprived of the grass roots. A pure clover sod (free from grasses and weeds) may, however, be used in the rotation before strawberries with good advantage except in districts in British Columbia where the strawberry root weevil is prevalent. If a clover sod is not desired in the rotation, have the strawberries follow a hoed crop which has been kept free from weeds.

(3) Make yourself acquainted with the insects likely to be troublesome in your district, and keep a careful watch for them on your plantation. Control measures, applied in good time, cost no more than if applied after much injury has been done, and the saving by timely attention may be considerable.

## LOOK FOR YOUR TROUBLE HERE

- (1) The blossom buds are found to be wilting and dropping off before opening. The flower petals of the early blossoms may have one or two "shot-holes" in them. *See under Strawberry Weevil.*
- (2) The leaves are pierced by numerous "shot-holes," especially in spring. *See under Strawberry Leaf Beetle.*
- (3) The leaves are folded over, often across the midrib, and if opened up are seen to be fastened at their edges by a "spider-web-like" material. Small active caterpillars will often be found in such leaves. *See under Strawberry Leaf Roller.*
- (4) The whole plant wilts down "overnight" and dries up. The plant is found to be cut off at or just below the ground level. Examination of the soil around the affected plant may reveal a dull-coloured, often coiled-up, caterpillar about an inch long. *See under Cutworms.*
- (5) Plants are unthrifty, make poor growth and often gradually wilt down. Examination of the roots shows that the fine fibres are lacking and the root consists mainly of large roots. Search the soil around affected plants carefully for grubs. (a) If a large whitish grub with six distinct brownish legs is found, usually doubled in the middle so that its tail end approaches its brownish head; *See under White Grubs.* (b) If a small whitish grub, not more than three-eighths inch long with its body curved but not doubled and with no distinct legs, is found; *See under Strawberry Root Weevil.*

## THE STRAWBERRY WEEVIL

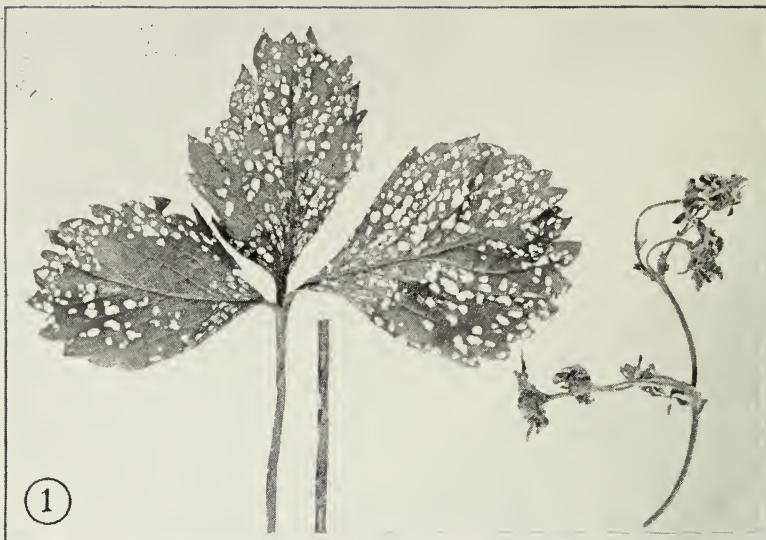
(Anthonomus signatus Say.)

Occasionally the yield of strawberry plantations is very seriously reduced by the strawberry weevil—a small reddish-brown or blackish snout beetle about  $\frac{1}{10}$  inch long, which cuts off the blossom buds. Early varieties of strawberries apparently are most subject to serious injury. Varieties with imperfect or pistillate flowers are practically immune.

**HABITS AND LIFE-HISTORY.**—The winter is passed in the adult age. The weevils hibernate under rubbish, particularly in woodlots and waste land adjoining the strawberry fields. In spring the insects leave their winter quarters and

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\* This section has been prepared by the Entomological Branch. Inquiries regarding insect pests should be directed to the Dominion Entomologist, Department of Agriculture, Ottawa. Letters and packages containing insects or their work weighing up to 12 ounces, may be sent through the mails free of postage.



(1)



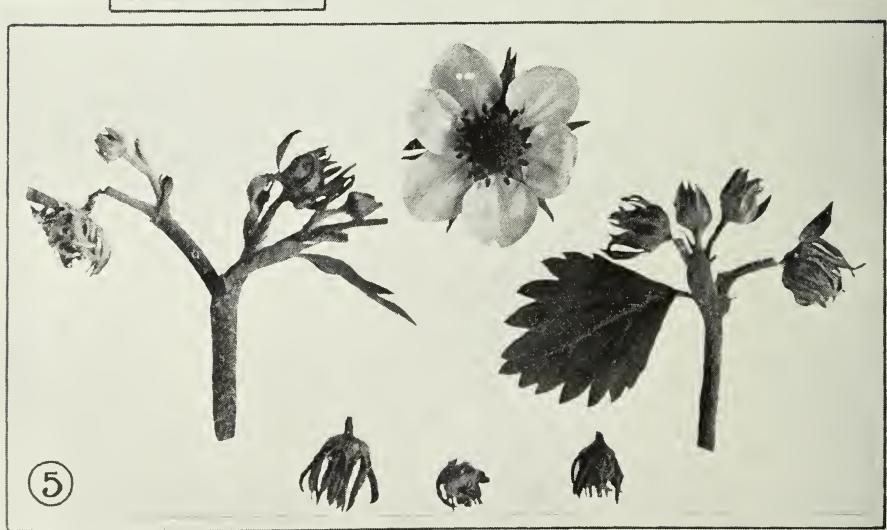
(2)



(3)



(4)



1. Work of Strawberry Leaf Beetle. 2. White Grub. 3. Strawberry Root Weevil.  
4. Cutworm. 5. Work of Strawberry Weevil.

appear on the strawberry plants about the time the first buds are forming. By means of her slender snout the female weevil punctures the blossom buds and deposits her oval, whitish eggs singly in the interior of the buds among the stamens. After depositing an egg the female then crawls down the blossom stem and girdles it so that the bud either falls immediately or is left hanging for a few days by a mere thread. On hot, still days the weevils are most active and can then be readily seen working on the buds. When cool, they usually hide and are difficult to locate. Within the severed buds the whitish larvae or grubs, which hatch out from the eggs, feed at first on the pollen and later on other interior parts. They become mature in about a month, pupate and emerge from the buds as adults during July. The new adults feed for a short time on the pollen of various flowers and then in midsummer they seek their hibernating quarters. There is only one generation a year.

**CONTROL.**—(1) Clean Farming: In combating this insect it is very important to secure as clean conditions as possible in and around the strawberry plantations. This involves the destruction of weeds, rubbish and anything which may afford the weevil winter protection. It is also advisable not to plant the strawberries near bush or waste land.

(2) Dusting: Almost complete protection from the weevil may be obtained by coating the plants with a dust composed of sulphur and arsenate of lead, either a 90-10 or 85-15 mixture. Ordinarily two applications are sufficient, the first when weevil feeding begins, and the second immediately after a washing rain, or seven days later than the first application, if the weather is dry. It is essential that all the buds be kept coated with the dust until they open. The only satisfactory way of applying the dust is with a power duster or a good make of hand-blower.

#### THE STRAWBERRY LEAF BEETLE

(*Paria canella* Fab.)

In Eastern Canada strawberries are occasionally injured by a dark brown or black, shiny, oval-shaped beetle about  $\frac{1}{8}$  inch long—the Strawberry Leaf Beetle. The leaves will be found riddled with "shot-holes" giving a lacework effect. In addition to the strawberry this insect may attack raspberry, blackberry, apple and some other plants.

**LIFE-HISTORY.**—The insect winters over in the adult stage. In all probability the beetles hibernate in rough or waste land, woodlots or possibly in the plantation itself where protection is afforded by old leaves or straw or some other mulch. As soon as growth commences in the spring the beetles fly to their food-plants and feed voraciously. In the case of strawberries they lay their eggs in the soil close to the crowns of the plants and on the underside of dead leaves lying around the plants. The very small grubs hatching out from these eggs burrow a little way into the soil and feed on the tiny rootlets of the strawberry plant which must further weaken the plant. When full grown the grubs are about  $\frac{1}{6}$  inch long. They then pupate in the soil and the new adult beetles emerge from about the end of July up to September. After feeding for a while, most of these new beetles leave the plantation for their winter quarters.

**CONTROL.**—As soon as the beetles are found feeding on the leaves, spray thoroughly with arsenate of lead (dry) 2 pounds, or calcium arsenate (dry)  $1\frac{1}{2}$  pounds, in 40 gallons of a 4-4-40 Bordeaux mixture.

## THE STRAWBERRY LEAF ROLLER

(Ancylis comptana Fröhl.)

This insect has not proved very troublesome in Canada although occasionally it has effected important injury. The caterpillars fold the leaves and fasten their edges with fine silken threads; they feed upon the surface of the leaves within the shelter thus formed.

**LIFE-HISTORY.**—The insect winters in the pupal, as well as in the nearly mature larval stage, in and around the strawberry plantation. In spring small inconspicuous moths, not quite  $\frac{3}{8}$ -inch long, emerge from the overwintering pupae, and the overwintering larvae soon pupate and yield more moths. The moths do not fly readily in the daytime, but where present in large numbers, may be disturbed by brushing a stick over the plants when they will come out in a small cloud and soon settle again. Eggs are laid by the moths, singly, on the upper and lower surfaces of the leaves, and are quite difficult to see as they are flattened against the surface. The caterpillars hatching therefrom feed on the leaf tissue and soon begin to tie the leaves together usually commencing by bridging across the hollow formed by the midrib on the upper surface of the leaf with silk. The silk strands are increased and tightened until the halves of the leaflet come together. In this shelter the larva is well protected. When full grown the caterpillars are about  $\frac{1}{2}$  inch long, greenish or brownish, and very active when disturbed. These pupate and a new brood of moths appear in late summer to repeat the process.

**CONTROL.**—If the presence of this insect is not detected until the leaves are folded, as is usually the case, the caterpillars are so well protected from spray materials that nothing can be done until the crop is harvested. As soon as the crop is off, run the mower over the rows and immediately rake the leaves between the rows and burn them. Next spring spray the plants just before the blossoms open with arsenate of lead (dry) 2 pounds, or calcium arsenate (dry)  $1\frac{1}{2}$  pounds, in 40 gallons of 4-4-40 Bordeaux mixture. Where the old plantation is not to be saved for another year, it is best to plough it under as soon as the crop is off in order to prevent the insects from infesting the new plantation.

The new plantation can be kept free by removing and crushing folded leaves at time of planting and by keeping the leaves coated with spray until the old plantation has been ploughed down or mowed off and the leaves burnt. Spray as soon as the plants are set out with the same mixture advised for the old plantation, and repeat when the coating becomes removed by heavy rain or when new unprotected growth appears. Protection by spray must be given until neighbouring sources of infestation have been removed or treated.

## CUTWORMS

Several of the well known cutworms may in any season cause much injury to young strawberry plants. In general, cutworms are similar in appearance, being smooth, cylindrical caterpillars about 1 inch or more in length and in colour some dull shade similar to the ground in which they hide during the day. Injury by cutworms usually ceases before the end of June. When they are present in numbers in a garden or field the plants will soon be seen to have been cut or eaten off, and if an examination is made, the cutworms will most likely be discovered in the soil coiled up and just below the surface.

**CONTROL.**—The poisoned-bran remedy is the one which is now used most extensively for the destruction of cutworms generally. This is made as follows:

Bran.....	20 pounds
Molasses.....	1 quart
Paris green or white arsenic.....	$\frac{1}{2}$ pound
Water.....	2 or $2\frac{1}{2}$ gallons

Mix the bran and Paris green (or white arsenic) thoroughly in a wash-tub, while dry. Dissolve the molasses in the water and wet the bran and poison with the same, stirring well so as to dampen the bran thoroughly.

Shorts or middlings in place of bran are also useful for cutworm control.

A simple formula for small gardens is 1 quart of bran, 1 teaspoonful of Paris green and 1 tablespoonful of molasses, with sufficient water to moisten the bran.

The mixture should be applied thinly as soon as cutworm injury is noticed. It is important too, that the mixture be scattered after sun-down, so that it will be in the very best condition when the cutworms come out to feed at night. This material is very attractive to them, and when they crawl about in search of food, they will eat it in preference to the growing vegetation. If the mixture is put out during a warm day, it soon becomes dry, and is not, of course, so attractive to the cutworms. In treating fields of strawberries, a simple method is to have a sack filled with the bran hung around the neck, and by walking between two rows and using both hands the mixture may be scattered along the row on either side. When cutworms are so numerous as to assume the walking habit, the poisoned bran may be spread just ahead of their line of march. In gardens, a small quantity of the material may be put around, but not touching, each plant.

#### WHITE GRUBS

(*Lachnostenra* spp.)

White grubs are the larvae of May Beetles or June Bugs and are well known to most growers. By feeding on the roots the larvae either kill or seriously weaken the strawberry plants. They are usually most troublesome where strawberries are planted after sod.

**LIFE-HISTORY.**—In May and June the beetles are commonly found flying about in the evenings and at night, particularly around trees upon the leaves of which they feed. They lay their eggs chiefly in sod land but also in land bearing such crops as timothy and small grains. The tiny grubs hatching from the eggs feed on the roots of the grasses and grains until late fall when they burrow deeper in the soil and remain dormant until the spring of the following year. With the warmer weather they come nearer the surface again and continue their feeding throughout the season. The next year they pupate in earthen cells during late summer, and later transform to the adult or beetle stage. The adult remains in the pupal cell until the following May or June when it comes out of the ground to fly around as the familiar June Bug.

**CONTROL.**—Preventive measures consist in avoiding land known to be infested with white grubs, and in growing for one or two years, prior to planting strawberries, such crops as beans, peas, buckwheat or pure stands of clover, all of which are more or less distasteful to the grubs. In breaking up old sod land allow chickens or hogs or both free access to the field; they will destroy many grubs. It is unwise to attempt planting strawberries right after sod where white grubs are found. If the plants are set in soil free from white grubs and the plantation kept free from weeds, there will be little to fear from white grubs.

Where the grubs are discovered in the plantation after it has been set out, nothing can be done to destroy them.

#### THE STRAWBERRY ROOT WEEVIL

(*Brachyrhinus ovatus* L.)

This insect, though found in nearly all sections of Canada where strawberries are grown, has proved destructive so far only on the Pacific coast. The chief injury is caused by the grubs feeding on the roots of the strawberry plants, weakening and sometimes killing them.

LIFE-HISTORY.—The adult is a very small, dark beetle, somewhat oval in shape and about  $\frac{1}{4}$  inch long. The beetles over-winter in almost any sheltered spot such as that afforded by rough land, fence-rows, heaps of brush and even in the strawberry plantation itself. The insect also winters as an immature grub in the soil around the roots of the strawberry plants. In the spring the beetles crawl (they have no wings and are unable to fly), to their many food plants. In British Columbia strawberry plants are an especial favourite. The immature grubs, which have lain dormant all winter, commence feeding again in the spring and soon reach maturity when they pupate in the soil and transform to adults towards the end of May. These new adults, together with those that have migrated to the strawberry patch from their winter quarters, may aggregate an enormous number of beetles. Every beetle is a female capable of laying fertile eggs. The eggs are laid in the soil usually near the crowns of the strawberry plants, and the larvae or grubs hatching therefrom feed upon the fine rootlets of the plants. A few of the grubs reach maturity in the fall and pupate in the soil. Adults from these emerge in the late fall and winter-over in sheltered spots indicated above. The majority of the larvae, however, remain dormant through the winter and mature the following spring.

CONTROL.—Mr. W. Downes, in charge of the Dominion Entomological Laboratory at Victoria, B.C., has demonstrated the value of the following poisoned bait for the destruction of the strawberry root weevil:

	Pounds
Cheap raisins (unseeded) . . . . .	100
Shorts . . . . .	100
Sodium fluosilicate . . . . .	10

The raisins should be soaked in water, using approximately 10 quarts to every 100 pounds, depending upon condition of raisins. The sodium fluosilicate should be mixed thoroughly with the shorts, after which the soaked raisins should be added and the whole passed slowly through a large meat chopper, set coarse, such as is used by purveyors. When required for use, the bait should be sufficiently moist so as to form a ball when squeezed in the hand.

One hundred pounds of the bait are required for each acre of mature plants. Apply by hand, placing a tablespoonful in the centre of each plant. Two applications should be made, the first in mid-April, the second in mid-June, dependent upon emergence of weevils on individual farms. Young plants require less bait.

## STRAWBERRY DISEASES

By G. H. BERKELEY, *Ph.D.*,

Plant Pathologist, Dominion Laboratory of Plant Pathology, St. Catharines, Ont.

### LEAF SPOT

Caused by *Mycosphaerella Fragariae* (Tul.) Lindau

This is the most widespread and best known disease of the strawberry, being found in almost every good-sized berry plantation in Ontario. Whether or not it causes economic losses in yield, will depend upon its prevalence. If only a few spots occur on a leaf it is doubtful if any damage occurs. If, on the other hand, the leaves are fairly well covered with spots, then considerable reduction in crop results, due to the fact that every "diseased" spot on the leaf lessens the amount of leaf-tissue that can function normally and produce food for general metabolism and the production of fruit. As a result, the plant is weakened in direct proportion to the number of leaf spots present, and as the supply of plant food is thus diminished, the number and size of berries found is likewise reduced. Where leaf spot is prevalent in a plantation, substantial loss of crop results. Growers generally overlook this fact, and think because the plant does not wilt or die outright that very little damage is effected.

This disease is recognized at first by small reddish or purplish spots which as they increase in size become paler in the centre until finally the centre is grey or almost white. A fully matured spot has therefore a white centre surrounded by a distinct purplish border, which ultimately merges into the green of the healthy leaf. The spots are scattered irregularly over the leaf-surface and when numerous may not only kill the leaf but in extreme cases also the plant.

The use of varieties that are known to show some resistance to this disease is a possible means of prevention. In this connection it must be pointed out that no variety is actually immune, and that even a seemingly resistant variety may be affected by leaf spot in some seasons, and in some districts. For instance, in 1923 the Parson showed strong resistance but in 1924 it appeared to be almost as badly diseased as other varieties. Yet in most seasons the following varieties should exhibit considerable resistance to leaf spot: Parson, Portia, Pocomoke, Lavinia, Splendid and William Belt.

**CONTROL.**—Where it is the practice to crop a plantation only once or twice, leaf spot is as a rule, not troublesome, and under such conditions of cultivation, spraying is often unnecessary. On the other hand where plantations are cropped three or four times (not the usual practice to-day) leaf spot may be expected to become prevalent and spraying may be necessary with Bordeaux 4:4:40 as soon as growth is well started in the spring. This should be followed by two or more applications with the same material so as to keep the leaves covered with Bordeaux mixture.

In the setting of a new plantation, do not use plants severely spotted with leaf spot but use only good, strong, healthy plants, removing any leaves that may be "spotted." Mowing off and burning old leaves also helps in checking leaf spot.

### LEAF SCORCH

Caused by *Diplocarpon earlianum* (E. & E.) Wolf

Scorch is also a leaf disease but is not so general in distribution as leaf spot. In its early stages it may easily be mistaken for leaf spot since the spots

in both cases are purplish in colour although the scorch blotch is more irregular in outline. Later, as the season advances these spots enlarge and coalesce. In severe cases the entire leaf may become purplish in colour. Soon the blotches become dry, and dark fruiting bodies of the fungus appear. As the disease progresses the leaves take on a dry burned appearance. In cases of severe infection the plants may be killed or so weakened as to be useless.

Leaf scorch is seldom very prevalent the first year of a new plantation.

**CONTROL.**—The same as for leaf spot; clean cultivation, destruction of old foliage, and spraying with Bordeaux mixture. See "leaf spot."

#### POWDERY MILDEW

Caused by *Sphaerotheca Humuli* (Fries) Burr

Mildew has long been recognized as a serious disease of the strawberry. It was severe in the Niagara peninsula in 1923 and to a lesser extent in 1924. The earliest and most conspicuous symptom of the disease is the curling of the leaves upward so that the lower surface is exposed. A close examination of the lower surface will show the white downy mycelium of the fungus which causes this disease. In severe cases the leaves become dry and the plant may be totally destroyed. If the attack of the mildew occurs before picking-time the loss in yield may be considerable to almost a complete failure.

The following varieties in most seasons exhibit considerable resistance to mildew attack: William Belt, Parson, Portia, Glen Mary, and Senator Dunlap.

**CONTROL.**—With mildew, as with leaf spot and leaf scorch, it has been found that careful sanitary measures usually prove sufficient protection. The use of sulphur dust has given good results. The sulphur may be applied by using a dusting machine; by shaking through a sieve; or by shaking a cotton bag filled with the sulphur over the rows to be treated. The first application should be applied upon the first indication of mildew. The number of additional "dustings" will depend largely upon weather conditions. It is generally necessary to make at least three applications.

Recently the New York (Geneva) Agricultural Experiment Station has demonstrated that mildew may be practically eliminated even during seasons of severe infection, by four applications of 85-15 lime-copper dust. The first application was made as the first buds were expanding in the cluster and the succeeding ones at twelve-day intervals.

#### GRAY MOLD

Caused by *Botrytis* sp.

This is a fruit disease and is found in some seasons to affect not only ripe fruit on the plant but partially matured fruit as well. It is of course likewise a source of infection to fruit in transit. In some years, considerable loss has been sustained in plantations in the Niagara peninsula due to early attacks of this fungus on green fruit, which results in the destruction of the fruit before it reaches maturity.

The disease is first apparent as a brown discoloration, which soon spreads throughout the berry until it is wholly rotten. Later the fruit dries out and is then soon covered with the fine grey powdery growth of the causal fungus.

The fungus develops best in moist, still air and thus is likely to be most destructive in old, weedy fields, in periods of heavy rainfall, or in poorly drained soil.

**CONTROL.**—Clean cultivation, freedom from weeds, good drainage, and sanitary measures are essentials in control. All berries showing signs of fruit

rot should be culled out during picking so as not to contaminate sound fruit in transit. Applications of Bordeaux mixture as outlined for leaf spot will also be of assistance in checking this trouble, but under Ontario conditions this is not generally necessary, as sanitary methods are usually sufficient.

### LEAK

The most common and destructive rot of strawberries in transit and storage is known as "leak", and is caused by the common bread mold (*Rhizopus nigricans*). It rots the ripe fruit rapidly and breaks down the tissues with a resulting loss of juice. It is not uncommon for the juice to drip from boxes of badly infected fruit.

The leak mold gains entrance through wounds and therefore sound fruit does not "leak." It is accordingly good practice to pick and pack fruit with the greatest care and to discard any soft, leak-like fruit. The leak fungus grows very slowly at temperatures below 50°F. Therefore if fruit is sound and is held at a low temperature the possibility of leak and fruit rots is diminished. Hence careful handling in picking, sorting, packing, and loading is absolutely essential if severe loss from rot is to be avoided. If berries are thus carefully handled, the chances of rot in transit are greatly lessened, particularly if they are not held at temperatures above 50°F.

### STRAWBERRY BLACK ROOT

During the last few years strawberry-growers have complained of a disease known as "black root" that has been destroying their strawberry patches. It is characteristic of this disease that the roots turn brown or black and the cortex (outer part) peels readily from the centre of the root. The leaves of root-rotted plants remain small, are bronze in colour and often become yellow, but eventually the plant, roots and crown, dies. Generally the diseased plant dies before picking time, although it is not unusual to see patches of diseased plants remain alive till some time after. Such plants produce small, green, immature and worthless berries. In nearly all cases this trouble appears in patches throughout the field. When such diseased plants are pulled up and the roots cut transversely it is noticed that the entire root is black. Healthy strawberry roots show a white core.

Observation has shown that this disease is more severe where strawberries follow strawberries year after year.

**CAUSE.**—It is not definitely known just what the cause or causes of this trouble may be. There is no doubt, however, that some of the so-called black root is due to winter-killing, or the alternate freezing and thawing of late fall or early spring. Winter injury of strawberries is apt to be most severe in a winter when the snow covering is scanty and alternate freezings and thawings occur. Although some cases are undoubtedly due to winter-killing, many are caused by some other agency. Examination made at the Dominion Laboratory of Plant Pathology at St. Catharines of hundreds of diseased crowns has shown the presence of mycelium in the wood elements, and isolations therefrom have repeatedly given almost pure cultures of *Fusarium* sp. There is therefore very good reason for believing that *Fusarium* sp. are responsible for this trouble although it is not improbable that other soil organisms may also be a factor in this connection. It is most likely that other factors, such as unfavourable locations, inadequate soil drainage, soil sickness, lack of fertility and faulty cultural practices may be the initial cause of this trouble, and the entrance of the soil organism is largely secondary.

**P**REVENTION.—Since the cause or causes of this trouble are not definitely known, definite control measures cannot be given at this time. However, from observations made in the field, we would suggest the following:—

#### *New Plantings*

1. Use only strong, vigorous plants with bright roots. Do not use plants with blackened roots.
2. Choose the location of your strawberry plantation having in mind that strawberries do best on sandy loam that is well drained and which tends to be acid.
3. Protect the plants during winter with proper mulch.
4. Strawberries should not follow strawberries. Practise crop rotation.
5. It is very important to plant the sets promptly so as not to allow the roots to dry out. Do not plant too deeply nor yet too shallow.

#### *Old Plantation*

If the old plantation is badly infected it will be more profitable to plough it up and set out a new planting elsewhere. If however the infection is slight the only suggestion that can be made is to improve general conditions by thorough cultivation, and applications of manure or nitrate of soda to stimulate growth.

#### STRAWBERRY MOSAIC?

During the last two seasons there have been many reports of a mosaic-like disease of strawberries in Ontario. This trouble occurred on several of the Experimental Farms this past season. Since this disease has been reported as present on most types of soil, conditions of the soil do not appear to be an important factor. Early in May a plantation of the Eaton variety of strawberry showed the characteristic mottled symptoms of mosaic. This first appeared as a yellowing along the edges of the rows, and later the whole plantation, at a distance, had a slightly yellowish colour in comparison with the green of the Premier variety growing adjacent. Close examination of the leaves showed a very marked yellowish to green mottling so characteristic of mosaic diseases. Along with this mottling was a puckering, and curling of the leaf. Dwarfing was also quite noticeable in most cases.

This trouble generally occurs in patches throughout the plantation, although more than one case has been observed where practically the entire plantation was affected. In the spring the diseased plants are conspicuous on account of their somewhat yellowish foliage and stunted growth. Such plants remain more or less stunted throughout the season, with the result that any fruit formed is small and of poor quality. In some cases the fruit dries up before maturity.

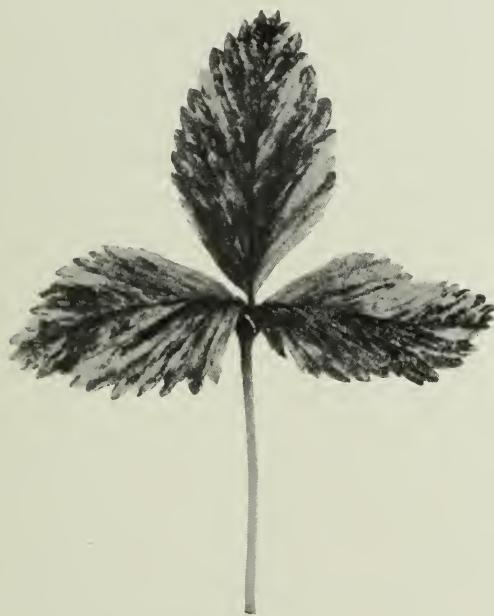
#### *Symptoms*

The most general and conspicuous symptoms of the disease are: (a) yellowing of unfolding leaves in early spring; (b) definite yellowish-green to green mottling of the streak type, with older leaves taking on greyish green areas, particularly around the margins; (c) puckering lengthwise of leaf tissue; (d) leaves are often unevenly formed, that is, one of the lateral leaf lobes is greatly reduced in size in comparison with the others; (e) general stunting of all parts of plant; (f) reduction in crop (g) all runners from diseased plants likewise diseased.

The following varieties have so far been found affected with this disease in Ontario: Eaton, Minnesota No. 3, Waites Everbearer, Van Dyke, and Grand Prize.

Close, careful examination of roots, crown and leaves for insects that might cause this trouble, showed the presence of aphids and red spiders on the leaves. The Premier and Cooper varieties lying right along side were also infested with these insects but showed no sign whatever of the mosaic symptoms. The mottling was not the characteristic grey mottling of the red spider attack; moreover during the dry period of late June, when the red spiders became very numerous, the mottled appearance began to disappear from the leaves. There was therefore not sufficient reason for believing that either the red spider or aphids were responsible for the mottling. Whether or not this is a true mosaic disease has yet to be ascertained.

CONTROL.—The only suggestion towards prevention that can be given at the present time, is to be sure that no sets for planting purposes come from such diseased plantations.



Strawberry Mosaic. Eaton variety.









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